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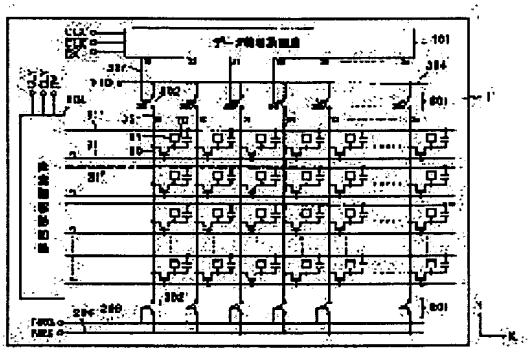
(54) ACTIVE MATRIX SUBSTRATE, LIQUID CRYSTAL DEVICE AND ELECTRONIC EQUIPMENT, AND METHOD FOR INSPECTING THE SAME ACTIVE MATRIX SUBSTRATE

(57)Abstract:

PROBLEM TO BE SOLVED: To actualize an inspecting function and a precharging function in a narrow area on an active matrix substrate prepared by forming scanning lines, data lines, TFTs, etc., thereon to constitute a liquid crystal device.

SOLUTION: An active matrix substrate is equipped with a data line driving circuit 101 provided on one end side of data lines 35, and an inspecting and precharging circuit 201 which is provided on the other end side and supplies an inspection signal to the data lines at the time of inspection performed before the liquid crystal device is assembled and a precharge signal to the data lines during normal operation.



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CLAIMS

[Claim(s)]
[Claim 1] Two or more scanning line and two or more data lines which are the active-matrix substrates for constituting the liquid crystal equipment with which it comes to pinch liquid crystal between the substrates of a pair, and carry out a phase crossover on one substrate of the substrates of said pair, The scanning-line drive circuit which supplies a scan signal to said two or more scanning lines, and a picture signal supply means to be formed in the end side of two or more of said data lines, and to supply a picture signal to said two or more data lines, Two or more picture element parts by which an active drive is carried out based on said scan signal with which it is prepared in the shape of a matrix, and is supplied through two or more of said scanning line and said two or more data lines, and said picture signal, respectively, It is prepared in the other end side of two or more of said data lines. The active-matrix substrate characterized by having the precharge [inspection-cum-] circuit which precedes the precharge signal of a predetermined voltage level with said picture signal at the time of normal operation, and is supplied to said two or more data lines, respectively while supplying an inspection signal to said two or more data lines at least, respectively at the time of inspection.
[Claim 2] Said precharge [inspection-cum-] circuit It is constituted including two or more precharge switches which carry out the switching output of the precharge signal inputted through a precharge signal line according to a precharge circuit driving signal, respectively, and are supplied to said two or more data lines as said inspection signal or said precharge signal, respectively. A sampling circuit with two or more sampling switches which said picture signal supply means samples the picture signal inputted through a picture signal line according to a sampling circuit driving signal, respectively, and are supplied to said two or more data lines as said picture signal, respectively, The active-matrix substrate according to claim 1 characterized by being constituted including the data-line drive circuit which supplies said sampling circuit driving signal to said two or more sampling switches, respectively.
[Claim 3] Said two or more precharge switches are active-matrix substrates according to claim 2 characterized by consisting of a thin film transistor by which said data line was connected to the source electrode, said precharge signal line was connected to the drain electrode, and said precharge circuit drive signal line was connected to the gate electrode, respectively.
[Claim 4] Said thin film transistor is a active-matrix substrate according to claim 3 characterized by consisting of one of an N channel mold transistor, a P channel mold transistor, and complementary transistors.
[Claim 5] said data line drive circuit be a active matrix substrate given in any 1 term of claims 2-4 characterize by have the wave control circuit which output as said sampling circuit driving signal after restrict the time amount die length of said transfer signal so that said transfer signal output almost simultaneously from each stage from two stages in the shift register and this shift register of one sequence which carry out the sequential output of the transfer signal which adjoin each other may not lap mutually in time .
[Claim 6] Said two or more picture element parts are active-matrix substrates given in any 1 term of claims 1-5 characterized by being constituted including the thin film transistor for an active drive, and said precharge [inspection-cum-] circuit consisting of same film as the thin film transistor of said picture element part including the thin film transistor formed in coincidence, respectively.
[Claim 7] Liquid crystal equipment characterized by equipping any 1 term of claims 1-6 with the active-matrix substrate of a publication, the substrate of another side of the substrates of said pair, and said liquid crystal.
[Claim 8] The seal member which sticks the substrate of said pair in the perimeter of the screen-display field

specified by said two or more picture element parts, and surrounds said liquid crystal, It has further circumference abandonment of the protection-from-light nature formed along with the profile of said screen-display field at the substrate of said another side between said seal members and said screen-display fields.
Liquid crystal equipment according to claim 7 characterized by being prepared in the location where at least one side of the I/O wiring of said precharge [inspection-cum-] circuit and said precharge [inspection-cum-] circuit counters said circumference abandonment.
[Claim 9] Electronic equipment characterized by having liquid crystal equipment according to claim 8.
[Claim 10] Making said two or more precharge switches of all into an ON state, while being the inspection approach of the active-matrix substrate a publication and carrying out normal operation of the (i) aforementioned data-line drive circuit to claims 2-6 measuring the current which impresses a predetermined electrical potential difference to said precharge signal line, and flows on said picture signal line -- or (ii) Making into an ON state two or more precharge switches of all driven to coincidence with said precharge circuit driving signal, while carrying out normal operation of said data-line drive circuit The inspection approach of the active-matrix substrate characterized by conducting disconnection or open-circuit inspection of two or more of said data lines by measuring the current which impresses a predetermined electrical potential difference to said picture signal line, and flows to said precharge signal line.
[Claim 11] Making said two or more precharge switches of all into an OFF state, while being the inspection approach of a active-matrix substrate given in claims 2-6 and making all the (i) aforementioned sampling switches into an ON state measuring the current which flows between the picture signal lines by which electrical installation is carried out to the data line which impresses a predetermined electrical potential difference and this adjoins each other between the picture signal lines by which electrical installation is carried out to the data line which adjoins each other -- or (ii) Making said two or more precharge switches of all into an ON state, while making said all sampling switches into an OFF state By measuring the current which flows between the precharge signal lines by which electrical installation is carried out to the data line which impresses a predetermined electrical potential difference and this adjoins each other between the precharge signal lines by which electrical installation is carried out to the data line which adjoins each other The inspection approach of the active-matrix substrate characterized by conducting shunt evaluation of two or more of said data lines.
[Claim 12] Making said two or more precharge switches of all into an ON state, while being the inspection approach of a active-matrix substrate given in claims 2-6 and making all the (i) aforementioned sampling switches into an OFF state measuring the current which impresses a predetermined electrical potential difference to said precharge signal line, and flows on said picture signal line -- or (ii) Making into an ON state two or more precharge switches of all driven to coincidence with said precharge circuit driving signal, while making said all sampling switches into an OFF state The inspection approach of the active-matrix substrate characterized by conducting leak inspection of said sampling switch by measuring the current which impresses a predetermined electrical potential difference to said picture signal line, and flows to said precharge signal line.
[Claim 13] Making said two or more precharge switches of all into an OFF state, while being the inspection approach of a active-matrix substrate given in claims 2-6 and making all the (i) aforementioned sampling switches into an ON state measuring the current which impresses a predetermined electrical potential difference to said precharge signal line, and flows on said picture signal line -- or (ii) by measuring the current which impresses a predetermined electrical potential difference to said picture signal line, and flows to said precharge signal line, making said two or more precharge switches of all into an OFF state, while making said all sampling switches into an ON state The inspection approach of the active-matrix substrate characterized by conducting leak inspection of said precharge switch.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention by forming driver elements, such as various wiring, such as the scanning line and the data line, and a thin film transistor (TFT being called suitably below), etc. on the substrate, and pinching liquid crystal between opposite substrates The active-matrix substrate which constitutes the liquid crystal equipment of a active-matrix drive method etc., It belongs to liquid crystal equipment equipped with this and electronic equipment, and a list at the technical field of various kinds of electrical property inspection approaches in such a active-matrix substrate. It belongs to technical fields, such as a active-matrix substrate of the format that circumference circuits, such as a precharge circuit and an inspection circuit, are especially formed on a substrate.
[0002]
[Description of the Prior Art] It is common that much pixel electrodes and TFT(s) are conventionally prepared on a glass substrate at many the scanning lines and the data-line lists which were arranged in all directions, respectively corresponding to each of these intersections in the active-matrix substrate for the liquid crystal equipments of the active-matrix drive method by TFT drive. Such a active-matrix substrate constitutes liquid crystal equipment by being stuck by an opposite substrate and the sealant and enclosing liquid crystal among both substrates. As for the faulty active-matrix substrate with which various wiring formed on the substrate has disconnected and short-circuited especially here, or TFT has produced leakage current, it is desirable from viewpoints of manufacture, such as increase in efficiency and low-cost-izing, to discover the active-matrix substrate concerned by which two or more formation was carried out before the scribe process separated mutually, and not to carry it in at degree process the front like the assembler who assembles the active-matrix substrate concerned to liquid-crystal equipment, and on a mother substrate. So, in addition to a scanning-line drive circuit, a data-line drive circuit, a sampling circuit, a precharge circuit, etc., the inspection circuit constituted possible [activation of electrical property inspection of the active-matrix substrate concerned before being assembled by liquid crystal equipment] may be established in this kind of active-matrix substrate as one of the circumference circuits formed in the boundary region of a screen-display field.
[0003] Two or more checking terminals for inputting or measuring the inspection signal supplied to the data line through checking driving signals, these switching elements, etc. for such an inspection circuit being equipped with switching elements, such as two or more TFT(s) connected to two or more data lines, respectively, and driving these switching elements are prepared on a substrate at dedication, and checking wiring to which from these checking terminals to an inspection circuit is connected further is prepared in dedication. and -- for example, the thing for which a checking driving signal is inputted to predetermined timing, applying a probe to a checking terminal and inputting the checking signal of a predetermined electrical potential difference into it -- the shut down inspection of two or more data lines, and open-circuit inspection -- further -- electrical property inspection of leak inspection of a sampling switch etc. -- the unit of each data line -- or it is constituted so that it can carry out in the unit of the group of two or more data lines.
[0004] On the other hand, among above-mentioned circumference circuits, especially a precharge circuit is the timing preceded with the picture signal supplied from a data-line drive circuit to the data line for the purpose of reduction of improvement in a contrast ratio, the stability of the potential level of the data line, and the Rhine unevenness on a display screen etc., and is a circuit which mitigates the load at the time of writing a picture signal in the data line by supplying a precharge signal. In case a picture signal will be written in the data line in 1H reversal drive method which reverses the electrical potential difference which

is reversed a predetermined period, and drives for example, impresses the electrical-potential-difference polarity of the data line usually performed to liquid crystal for every scanning line if the precharge signal is beforehand written in the data line in order to carry out the alternating current drive especially of the liquid crystal, required quantity of electricity can be lessened notably. For example, an example of such a precharge circuit is indicated by JP,7-295520,A. Moreover, a sampling circuit is a circuit which samples a picture signal, in order to supply the picture signal of high frequency to each data line stably to predetermined timing synchronizing with a scan signal.

[0005] Here, if the substrate size of the liquid crystal equipment equipped with the circumference circuit on the substrate as mentioned above is the same, the screen-display field specified by two or more picture element parts arranged in the shape of a matrix, i.e., the field as which an image is actually displayed by change of the orientation condition of liquid crystal on liquid crystal equipment, is made so good that it is large as a fundamental request of a display. Therefore, it is common that circumference circuits including the inspection circuit and precharge circuit which were mentioned above are established in a long and slender circumference part with the narrow substrate located in the perimeter of a screen-display field.

[0006]

[Problem(s) to be Solved by the Invention] However, if it is going to establish both the inspection circuits and precharge circuits which were mentioned above in the circumference part of a active-matrix substrate, the trouble that reservation of the formation field of TFT, leading about of wiring, etc. which constitute these circuits become difficult will arise. That is, when it prepares in the above-mentioned narrow long and slender circumference part to a sampling circuit, a precharge circuit, an inspection circuit, etc. in addition to a scanning-line drive circuit or a data-line drive circuit, there is a trouble that it becomes difficult to design these circumference circuits so that a specific specification may be met.

[0007] About the checking terminal which is needed when preparing especially an inspection circuit, the area of a terminal area becomes about 100micrometerx100micrometer from the relation of standing a probe. That is, there is a trouble that the precious field on such a substrate side will be occupied for inspection conducted before the assembly of liquid crystal equipment. In addition, since the checking terminal prepared on the substrate side in this way usually consists of metal thin films, such as aluminum (aluminum), etc. and is left behind as it is also at the time of un-using it after inspection, it also has the trouble that it corrodes after being produced commercially, and liquid crystal equipment is not worsened or the quality of a display image may be reduced.

[0008] This invention is made in view of the trouble mentioned above, and let it be a technical problem to provide with the inspection approach of this active-matrix substrate the active-matrix substrate, the liquid crystal equipment using this, and the electronic equipment list for [which realizes a precharge function and a checking feature using the comparatively narrow field on a substrate] liquid crystal equipments.

[0009]

[Means for Solving the Problem] In order that a active-matrix substrate according to claim 1 may solve the above-mentioned technical problem Two or more scanning line and two or more data lines which are the active-matrix substrates for constituting the liquid crystal equipment with which it comes to pinch liquid crystal between the substrates of a pair, and carry out a phase crossover on one substrate of the substrates of said pair, The scanning-line drive circuit which supplies a scan signal to said two or more scanning lines, and a picture signal supply means to be formed in the end side of two or more of said data lines, and to supply a picture signal to said two or more data lines, Two or more picture element parts by which an active drive is carried out based on said scan signal with which it is prepared in the shape of a matrix, and is supplied through two or more of said scanning line and said two or more data lines, and said picture signal, respectively, It is prepared in the other end side of two or more of said data lines. While supplying an inspection signal to said two or more data lines at least, respectively at the time of inspection, it is characterized by having the precharge [inspection-cum-] circuit which precedes the precharge signal of a predetermined voltage level with said picture signal at the time of normal operation, and is supplied to said two or more data lines, respectively.

[0010] According to the active-matrix substrate according to claim 1, a picture signal supply means to supply a picture signal to two or more data lines is formed in the end side of two or more data lines, and the precharge [inspection-cum-] circuit is established in the other end side of two or more data lines. Here, at the time of inspection, the inspection signal for performing electrical property inspection of a predetermined class to two or more data lines at least is supplied by the precharge [inspection-cum-] circuit, respectively. Therefore, electrical property inspection of predetermined classes, such as the disconnection or open-circuit inspection to the picture element part connected to each data line located among both, respectively or this,

and shunt evaluation, can be conducted using a precharge [inspection-cum-] circuit, and a picture signal supply means.
[0011] On the other hand, at the time of normal operation, the precharge signal of a predetermined voltage level precedes with the picture signal supplied from a picture signal supply means, and is supplied to two or more data lines by the precharge [inspection-cum-] circuit, respectively. And a picture signal is supplied to two or more data lines by the picture signal supply means. That is, supply of the picture signal over each data line which precharge about each data line was performed by the precharge [inspection-cum-] circuit, and was precharged will be performed by the picture signal supply means good.
[0012] As mentioned above, since a precharge [inspection-cum-] circuit has a checking feature in the case of inspection carried out a front, in front of a scribe process, etc. and has a precharge function like the assembler to liquid-crystal equipment in the case of the normal operation after the assembly to liquid-crystal equipment, a substrate top field required in order to realize these two functions is notably small, and ends as compared with the case where an inspection circuit and a precharge circuit are separately established in the circumference part of a substrate like before.
[0013] A active-matrix substrate according to claim 2 is set to a active-matrix substrate according to claim 1. Said precharge [inspection-cum-] circuit It is constituted including two or more precharge switches which carry out the switching output of the precharge signal inputted through a precharge signal line according to a precharge circuit driving signal, respectively, and are supplied to said two or more data lines as said inspection signal or said precharge signal, respectively. A sampling circuit with two or more sampling switches which said picture signal supply means samples the picture signal inputted through a picture signal line according to a sampling circuit driving signal, respectively, and are supplied to said two or more data lines as said picture signal, respectively, It is characterized by being constituted including the data-line drive circuit which supplies said sampling circuit driving signal to said two or more sampling switches, respectively.
[0014] According to the active-matrix substrate according to claim 2, two or more sampling switches which can be set to a sampling circuit are constituted so that the picture signal inputted through a picture signal line may be sampled according to a sampling circuit driving signal, respectively, and the data-line drive circuit is constituted so that a sampling circuit driving signal may be supplied to two or more sampling switches, respectively. Here, in a precharge circuit, according to a precharge circuit driving signal, a switching output is carried out by two or more precharge switches, and the precharge signal inputted through a precharge signal line is supplied to two or more data lines as an inspection signal, respectively at the time of inspection. Therefore, electrical property inspection of the predetermined class over each data line located, respectively between two or more precharge switches and two or more sampling switches can be conducted using a precharge switch, a sampling switch, and a data-line drive circuit.
[0015] On the other hand, in a precharge circuit, according to a precharge circuit driving signal, a switching output is carried out by two or more precharge switches, and the precharge signal inputted through a precharge signal line is supplied to two or more data lines as a precharge signal, respectively at the time of normal operation. And in a picture signal supply means, if a sampling circuit driving signal is supplied to two or more sampling switches by the data-line drive circuit, respectively, according to a sampling circuit driving signal, the picture signal inputted through a picture signal line will be sampled by two or more sampling switches, respectively, and will be supplied to two or more data lines as a picture signal, respectively. That is, precharge about each data line will be performed by the precharge [inspection-cum-] circuit, and supply of the picture signal over each precharged data line will be performed by the picture signal supply means good.
[0016] In a active-matrix substrate according to claim 2, said data line is connected to a source electrode, and, as for a active-matrix substrate according to claim 3, said precharge signal line is characterized by consisting of a thin film transistor by which connected with the drain electrode and said precharge circuit drive signal line was connected to the gate electrode, respectively, as for said two or more precharge switches.
[0017] The thin film transistor which makes two or more precharge switches will be in an ON state, respectively, if a precharge circuit driving signal is supplied to a gate electrode through a precharge circuit drive signal line, and according to the active-matrix substrate according to claim 3, it supplies the precharge signal supplied to a drain electrode through a precharge signal line from a source electrode as a precharge signal as an inspection signal to the data line at the time of normal operation at the time of inspection.
[0018] Therefore, at the time of inspection, electrical property inspection of the predetermined class over each data line located between these thin film transistors and two or more sampling switches, respectively

can be conducted using the switching operation of these thin film transistors. Moreover, using the switching operation of these thin film transistors, precharge about each data line will be performed and supply of the picture signal over each precharged data line will be performed by the picture signal supply means good at the time of normal operation.

[0019] A active-matrix substrate according to claim 4 is characterized by said thin film transistor consisting of one of an N channel mold transistor, a P channel mold transistor, and complementary transistors in a active-matrix substrate according to claim 3.

[0020] According to the active-matrix substrate according to claim 4, using TFT of an N channel mold transistor and a P channel mold transistor, i.e., a piece channel, and the switching operation of the precharge switch which consists of a complementary transistor constituted from an N channel mold transistor and a P channel mold transistor, electrical property inspection of a predetermined class can be ensured at the time of inspection, and precharge can be ensured at the time of normal operation.

[0021] A active-matrix substrate according to claim 5 is set to a active-matrix substrate given in any 1 term of claims 2-4. Said data-line drive circuit The shift register of one sequence which carries out the sequential output of the transfer signal from each stage, After restricting the time amount die length of said transfer signal so that said transfer signal outputted almost simultaneously from two stages in this shift register which adjoin each other may not lap mutually in time, it is characterized by having the wave control circuit outputted as said sampling circuit driving signal.

[0022] According to the active-matrix substrate according to claim 5, if the sequential output of the transfer signal is carried out from each stage of the shift register of one sequence, after the time amount die length of a transfer signal is restricted by the wave control circuit, it will be outputted by it as a sampling circuit driving signal, so that the transfer signal outputted almost simultaneously from this shift register may not lap mutually in time. Therefore, it originates in actuation of the sampling switch corresponding to the time lap in the transfer signal which gets mixed up, and the situation where a picture signal, an inspection signal, and a precharge signal will be supplied ranging over two or more data lines can be prevented. and if a precharge signal is made into two sequences even when it can be managed with one sequence and will perform the above-mentioned 1H reversal drive, if the precharge signal and precharge circuit driving signal which will be supplied to a precharge [inspection-cum-] circuit if constituted in this way are the case where 1H reversal drive like the above-mentioned is not performed, respectively, it is sufficient for them with one sequence a precharge circuit driving signal. Therefore, as compared with the case where a sampling switch is driven by the data-line drive circuit based on the transfer signal of two or more sequences outputted from the shift register of two or more sequences, the number of I/O wiring for a precharge signal or precharge circuit driving signals concerning a precharge [inspection-cum-] circuit or input/output terminals can be reduced sharply.

[0023] A active-matrix substrate according to claim 6 is characterized by constituting said two or more picture element parts including the thin film transistor for an active drive, respectively, and said precharge [inspection-cum-] circuit consisting of same film as the thin film transistor of said picture element part including the thin film transistor formed in coincidence in a active-matrix substrate given in any 1 term of claims 1-5.

[0024] Since it is formed in coincidence from the film with same thin film transistor in a picture element part and thin film transistor in a precharge [inspection-cum-] circuit according to the active-matrix substrate according to claim 6, manufacture of these thin film transistors is comparatively easy, and can attain low cost-ization of the whole equipment.

[0025] Liquid crystal equipment according to claim 7 is characterized by equipping any 1 term of claims 1-6 with the active-matrix substrate of a publication, the substrate of another side of the substrates of said pair, and said liquid crystal.

[0026] According to liquid crystal equipment according to claim 7, it has the active-matrix substrate of this invention mentioned above, and is constituted, and since various kinds of pre- electrical property inspection is ensured, it is as reliable as an assembler. Moreover, since neither I/O wiring only for an inspection circuit or inspection circuits nor an input/output terminal exists, the circumference circuit for performing normal operation, such as a precharge circuit, a sampling circuit, a data-line drive circuit, and a scanning-line drive circuit, can form with allowances.

[0027] Liquid crystal equipment according to claim 8 is set to liquid crystal equipment according to claim 7. The seal member which sticks the substrate of said pair in the perimeter of the screen-display field specified by said two or more picture element parts, and surrounds said liquid crystal, It has further circumference abandonment of the protection-from-light nature formed along with the profile of said screen-display field at

the substrate of said another side between said seal members and said screen-display fields. At least one side of the I/O wiring of said precharge [inspection-cum-] circuit and said precharge [inspection-cum-] circuit is characterized by being prepared in the location which counters said circumference abandonment.
[0028] According to liquid crystal equipment according to claim 8, circumference abandonment of protection-from-light nature is formed along with the profile of a screen-display field at the 2nd substrate between the seal member and the screen-display field on the substrate (namely, opposite substrate) of another side. And either [at least] a precharge [inspection-cum-] circuit or its I/O wiring is prepared in one substrate in the location (henceforth "the bottom of circumference abandonment") which counters circumference abandonment. Here, a precharge [inspection-cum-] circuit is a circuit of an alternating current drive fundamentally at the time of normal operation. For this reason, while faces the liquid crystal which was surrounded by the seal member and pinched among both substrates, and even if it prepares a precharge [inspection-cum-] circuit, and its I/O wiring in a substrate part, the problem of degradation of the liquid crystal by direct-current-voltage impression is not produced. And in this way, by preparing a precharge [inspection-cum-] circuit, and its I/O wiring in the bottom of circumference abandonment, it can have allowances and for example, a scanning-line drive circuit and a data-line drive circuit can be formed in the circumference part of a narrow long and slender substrate.
[0029] Electronic equipment according to claim 9 is characterized by having liquid crystal equipment according to claim 8.
[0030] Since according to electronic equipment according to claim 9 it has liquid crystal equipment of this invention mentioned above and is constituted, the miniaturization is attained, high definition actuation is possible, and, moreover, it is reliable.
[0031] The inspection approach of a active-matrix substrate according to claim 10 Making said two or more precharge switches of all into an ON state, while being the inspection approach of inspecting the active-matrix substrate of a publication and carrying out normal operation of the (i) aforementioned data-line drive circuit to claims 2-6 measuring the current which impresses a predetermined electrical potential difference to said precharge signal line, and flows on said picture signal line -- or (ii) Making into an ON state two or more precharge switches of all driven to coincidence with said precharge circuit driving signal, while carrying out normal operation of said data-line drive circuit By measuring the current which impresses a predetermined electrical potential difference to said picture signal line, and flows to said precharge signal line, it is characterized by conducting disconnection or open-circuit inspection of two or more of said data lines.
[0032] A predetermined electrical potential difference is impressed to a precharge signal line, making two or more precharge switches of all into an ON state according to the inspection approach of a active-matrix substrate according to claim 10, while carrying out normal operation of the (i) data-line drive circuit. Then, the predetermined electrical potential difference impressed to the precharge signal line is impressed to each data line through the precharge switch made into the ON state. And since it is turned on in the group unit which a sampling switch becomes from a data-line unit or two or more data lines, when each data line and each picture signal line are made into switch-on, a current flows on a picture signal line. Then, the current which flows on this picture signal line is measured, and if it compares with the reference current obtained when the picture element part connected to the data line or this is in a normal state, disconnection or an open circuit of the data line can be inspected in the group unit which consists of a data-line unit or two or more data lines.
[0033] Or a predetermined electrical potential difference is impressed to a picture signal line, making into an ON state two or more precharge switches of all driven to coincidence with a precharge circuit driving signal, while carrying out normal operation of the (ii) data-line drive circuit. Then, the predetermined electrical potential difference impressed to the picture signal line is sampled by the sampling switch, and is impressed to each data line. And since the precharge switch is turned on and each data line and a precharge signal line are made into switch-on, a current flows to a precharge signal line with the electrical potential difference impressed to each data line. Then, if it compares with the reference current obtained when the current which flows to this precharge signal line is measured and the data line etc. is in a normal state, disconnection or an open circuit of the data line can be inspected in the group unit which consists of a data-line unit or two or more data lines.
[0034] The inspection approach of a active-matrix substrate according to claim 11 Making said two or more precharge switches of all into an OFF state, while being the inspection approach of inspecting the active-matrix substrate of a publication to claims 2-6 and making all the (i) aforementioned sampling switches into an ON state measuring the current which flows between the picture signal lines by which electrical

installation is carried out to the data line which impresses a predetermined electrical potential difference and this adjoins each other between the picture signal lines by which electrical installation is carried out to the data line which adjoins each other -- or (ii) Making said two or more precharge switches of all into an ON state, while making said all sampling switches into an OFF state By measuring the current which flows between the precharge signal lines by which electrical installation is carried out to the data line which impresses a predetermined electrical potential difference and this adjoins each other between the precharge signal lines by which electrical installation is carried out to the data line which adjoins each other, it is characterized by conducting shunt evaluation of two or more of said data lines.

[0035] A predetermined electrical potential difference is impressed between the picture signal lines by which electrical installation is carried out to the data line which adjoins each other, making two or more precharge switches of all into an OFF state according to the inspection approach of a active-matrix substrate according to claim 11, while making all the (i) sampling switches into an ON state. Then, although a predetermined electrical potential difference is impressed to the data line from a picture signal line through a sampling switch, since all precharge switches are turned off, the data line which adjoins each other is insulated mostly mutually, and the current should not flow between picture signal lines. Then, if it compares with the reference current obtained when the current which flows between the picture signal lines by which electrical installation is carried out to the data line which adjoins each other is measured and the data line etc. is in a normal state in this condition (close to about 0), the short circuit of the data line can be inspected in the group unit which consists of a data-line unit or two or more data lines.

[0036] Or a predetermined electrical potential difference is impressed between the precharge signal lines by which electrical installation is carried out to the data line which adjoins each other, making two or more precharge switches of all into an ON state, while making all the (ii) sampling switches into an OFF state. Then, although a predetermined electrical potential difference is impressed to the data line from a precharge signal line through a precharge switch, since all sampling switches are turned off, the data line which adjoins each other is insulated mostly mutually, and the current should not flow between precharge signal lines. Then, if it compares with the reference current obtained when the current which flows between the precharge signal lines by which electrical installation is carried out to the data line which adjoins each other is measured and the data line is in a normal state in this condition (close to about 0), the short circuit of the data line can be inspected in the group unit which consists of a data-line unit or two or more data lines.

[0037] The inspection approach of a active-matrix substrate according to claim 12 Making said two or more precharge switches of all into an ON state, while being the inspection approach of inspecting the active-matrix substrate of a publication to claims 2-6 and making all the (i) aforementioned sampling switches into an OFF state measuring the current which impresses a predetermined electrical potential difference to said precharge signal line, and flows on said picture signal line -- or (ii) Making into an ON state two or more precharge switches of all driven to coincidence with said precharge circuit driving signal, while making said all sampling switches into an OFF state By measuring the current which impresses a predetermined electrical potential difference to said picture signal line, and flows to said precharge signal line, it is characterized by conducting leak inspection of said sampling switch.

[0038] A predetermined electrical potential difference is impressed to a precharge signal line, making two or more precharge switches of all into an ON state according to the inspection approach of a active-matrix substrate according to claim 12, while making all the (i) sampling switches into an OFF state. Then, although a predetermined electrical potential difference is impressed to the data line from a precharge signal line through a precharge switch, since all sampling switches are turned off, a current should not flow on a picture signal line from the data line with the predetermined electrical potential difference of the data line. Then, if it compares with the reference current obtained when the current which flows on a picture signal line is measured and a sampling switch is in a normal state in this condition (close to about 0), leak of a sampling switch can be inspected in the group unit which consists of a data-line unit or two or more data lines.

[0039] Or a predetermined electrical potential difference is impressed to a picture signal line, making into an ON state two or more precharge switches of all driven to coincidence with a precharge circuit driving signal, while making all the (ii) sampling switches into an OFF state. Then, since all sampling switches are turned off, a current should not flow to a precharge signal line through the data line and a precharge switch with the predetermined electrical potential difference of a picture signal line. Then, if it compares with the reference current obtained when the current which flows to a precharge signal line is measured and a sampling switch is in a normal state in this condition (close to about 0), leak of a sampling switch can be inspected in the group unit which consists of a data-line unit or two or more data lines.

[0040] The inspection approach of a active-matrix substrate according to claim 13 Making said two or more precharge switches of all into an OFF state, while being the inspection approach of inspecting the active-matrix substrate of a publication to claims 2-6 and making all the (i) aforementioned sampling switches into an ON state measuring the current which impresses a predetermined electrical potential difference to said precharge signal line, and flows on said picture signal line -- or (ii) by measuring the current which impresses a predetermined electrical potential difference to said picture signal line, and flows to said precharge signal line, making said two or more precharge switches of all into an OFF state, while making said all sampling switches into an ON state It is characterized by conducting leak inspection of said precharge switch.
[0041] A predetermined electrical potential difference is impressed to a precharge signal line, making two or more precharge switches of all into an OFF state according to the inspection approach of a active-matrix substrate according to claim 13, while making all the (i) sampling switches into an ON state. Then, since all precharge switches are turned off, a current should not flow on a picture signal line through the data line and a sampling switch with the predetermined electrical potential difference of a precharge signal line. Then, if it compares with the reference current obtained when the current which flows on a picture signal line is measured and a precharge switch is in a normal state in this condition (close to about 0), leak of a precharge switch can be inspected in the group unit which consists of a data-line unit or two or more data lines.
[0042] Or a predetermined electrical potential difference is impressed to a picture signal line, making two or more precharge switches of all into an OFF state, while making all the (ii) sampling switches into an ON state. Then, although a predetermined electrical potential difference is impressed to the data line from a picture signal line through a sampling switch, since all precharge switches are turned off, a current should not flow from the data line to a precharge signal line with the predetermined electrical potential difference of the data line. Then, if it compares with the reference current obtained when the current which flows to a precharge signal line is measured and a precharge switch is in a normal state in this condition (close to about 0), leak of a precharge switch can be inspected in the group unit which consists of a data-line unit or two or more data lines.
[0043] Such an operation and other gains of this invention are made clear from the gestalt of the operation explained below.
[0044]
[Embodiment of the Invention] Hereafter, the gestalt of operation of this invention is explained based on a drawing.
[0045] (Configuration of a active-matrix substrate) The configuration of the gestalt of operation of the active-matrix substrate of this invention is explained based on drawing 3 from drawing 1 .
[0046] First, the circuitry of the whole active-matrix substrate is explained with reference to drawing 1 . Drawing 1 is representative circuit schematics, such as various wiring, a circumference circuit, etc. which were established in the active-matrix substrate.
[0047] The active-matrix substrate is equipped with the TFT array substrate 1 which consists of a quartz substrate, hard glass, a silicon substrate, etc. in drawing 1 . Two or more pixel electrodes 11 prepared in the shape of a matrix on the TFT array substrate 1, The data line 35 which two or more arrays are carried out in the direction of X, and is extended along the direction of Y, respectively, The scanning line 31 which two or more arrays are carried out in the direction of Y, and is extended along the direction of X, respectively, While intervening between each data line 35 and the pixel electrode 11, respectively, two or more TFT30 as an example of the switching element which controls the switch-on and the non-switch-on between these according to the scan signals Y1, Y2, --, Ym supplied through the scanning line 31, respectively, respectively is formed. Moreover, on the TFT array substrate 1, capacity line 31' which is wiring for storage capacitance 70 is formed almost in parallel along with the scanning line 31, and storage capacitance 70 is added to the pixel electrode 11. Thereby, parasitic capacitance can prevent degradation of display grace, such as a flicker produced owing to. In addition, although storage capacitance 70 is formed, the scanning line 31 of the preceding paragraph may be used as an electrode for storage capacitance formation. If such a configuration is taken, since it is not necessary to prepare capacity line 31', a pixel numerical aperture can be raised and bright liquid crystal equipment can be offered. By the way, the picture signals S1, S2, --, Sn written in the data line 35 may be supplied to line sequential, and you may make it supply them to this order for every group to two or more data-line 35 comrades which adjoin each other. Thus, two or more data lines 35 which adjoin each other are driven to coincidence, by shifting the phase of a picture signal, it becomes possible to reduce the drive frequency of a data-line drive circuit, and circuit reliability and low-power-ization can be realized.

[0048] At the time of the inspection in the preceding paragraph story further assembled by liquid crystal equipment 200 (it mentions later) on the TFT array substrate 1 The checking feature which conducts various kinds of electric inspection, such as disconnection of the TFT30 grade of the picture element part connected to the data line 35 or this or open-circuit inspection, and shunt evaluation, The precharge signal NRS of a predetermined voltage level to two or more data lines 35 at the time of the normal operation of liquid crystal equipment 200 Picture signals S1 and S2, --, The precharge [inspection-cum-] circuit 201 equipped with both functions with the precharge function which precedes with Sn and is supplied, respectively, The sampling circuit 301 which samples picture signals S1, S2, --, Sn, and is supplied to two or more data lines 35, respectively, the data-line drive circuit 101, and the scanning-line drive circuit 104 are formed.
[0049] The scanning-line drive circuit 104 impresses the scan signals Y1, Y2, --, Ym to the scanning line 31 (gate electrode line) by line sequential in pulse to predetermined timing based on the power source supplied from an external control circuit, a reference clock CLY, its reversal clock, etc.
[0050] Based on the power source supplied from an external control circuit, a reference clock CLX, its reversal clock, etc., according to the timing which impresses the scan signals Y1, Y2, --, Ym, the sampling circuit driving signals SH1, SH2, --, SHn are minded every data line 35, and the scanning-line drive circuit 104 minds [301] the sampling circuit drive signal line 306, and supplies the data-line drive circuit 101 to predetermined timing about picture signal line 304 each.
[0051] As a switching element, it has TFT202 every data line 35, the precharge signal line 204 is connected to the drain or source electrode of TFT202, and, as for the precharge [inspection-cum-] circuit 201, the precharge circuit drive signal line 206 is connected to the gate electrode of TFT202. And the power source of a predetermined electrical potential difference required at the time of normal operation, in order to write in the precharge signal NRS from an external power through the precharge signal line 204 is supplied, and the precharge circuit driving signal NRG is supplied from an external control circuit so that the precharge signal NRS may be written in through the precharge circuit drive signal line 206 to the timing preceded with picture signals S1, S2, --, Sn about each data line 35. The precharge [inspection-cum-] circuit 201 supplies the precharge signal NRS (image auxiliary signal) which is preferably equivalent to the picture signals S1, S2, --, Sn of middle gradation level. Moreover, at the time of inspection, that electric inspection of a predetermined class should be carried out like the after-mentioned, a checking electrical potential difference is impressed to the data line 35, or the precharge [inspection-cum-] circuit 201 is constituted so that it may be possible to pass a checking current.
[0052] The sampling circuit 301 is equipped with TFT302 every data line 35, the picture signal line 304 is connected to the source electrode of TFT302, and the sampling circuit drive signal line 306 is connected to the gate electrode of TFT302. And these will be sampled if picture signals S1, S2, --, Sn are inputted through the picture signal line 304. That is, if the sampling circuit driving signals SH1, SH2, --, SHn are inputted from the data-line drive circuit 101 through the sampling circuit drive signal line 306, sequential impression of the picture signals S1, S2, --, Sn will be carried out about picture signal line 304 each at the data line 35.
[0053] Thus, it consists of gestalten of this operation so that the data line 35 may be chosen for [every], but you may constitute so that the data line 35 may be packed two or more [every] and coincidence selection may be made. For example, according to the write-in property of TFT302 which constitutes a sampling circuit 301, and the frequency of a picture signal, the picture signals S1, S2, --, Sn by which phase expansion was carried out may be supplied to two or more phases (for example, a three phase circuit, six phases, 12 phases, --) from the picture signal line 304, and you may constitute so that these may be sampled to coincidence for every group. Under the present circumstances, as for it being the need, only the number of phase expansions cannot be overemphasized by the picture signal line 304 at least.
[0054] Next, the concrete circuitry of TFT 202 and 302 which constitutes the precharge [inspection-cum-] circuit 201 and a sampling circuit 301 is explained with reference to drawing 2 and drawing 3 , respectively. In addition, drawing 2 is the circuit diagram showing various kinds of TFT(s) which constitute TFT202 of the precharge [inspection-cum-] circuit 201, and drawing 3 is the circuit diagram showing various kinds of TFT(s) which constitute TFT302 of a sampling circuit 301.
[0055] As shown in drawing 2 (1), TFT202 (refer to drawing 1) of the precharge circuit 201 may consist of N channel mold TFT202a, as shown in drawing 2 (2), may consist of P channel mold TFT202b, and may consist of complementary-type TFT202c which consists of the N channel mold TFT and the P channel mold TFT as shown in drawing 2 (3). In addition, the precharge circuit driving signals 206a and 206b inputted in drawing 2 (3) through the precharge circuit drive signal line 206 shown in drawing 1 from drawing 2 (1) are inputted into each TFT(s) 202a-202c as gate voltage. The precharge signal NRS inputted through the

precharge signal line 204 similarly shown in drawing 1 is inputted into each TFT(s) 202a-202c as a source electrical potential difference. Precharge circuit driving signal 206a impressed to N channel mold TFT202a as gate voltage and precharge circuit driving signal 206b impressed to P channel mold TFT202b as gate voltage are reversal signals mutual. Therefore, in constituting the precharge circuit 201 from complementary-type TFT202c, at least two or more precharge circuit drive signal lines 206 are needed. Thus, when the precharge circuit drive signal line 206 becomes two or more, one screen-display field side may be wired intensively, and you may wire from the both sides of a screen-display field combining the precharge signal line 204. or -- for example, precharge circuit driving signal 206a may be reversed with an inverter before [that each or plurality adjoins each other] complementary-type TFT202c, and precharge circuit driving signal 206b may be formed.

[0056] As shown in drawing 3 (1), TFT302 (refer to drawing 1) of a sampling circuit 301 may consist of N channel mold TFT302a, as shown in drawing 3 (2), it may consist of P channel mold TFT302b, and as shown in drawing 3 (3), it may consist of complementary-type TFT302c. In addition, the picture signal VID inputted in drawing 3 (3) through the picture signal line 304 shown in drawing 1 from drawing 3 (1) is inputted into each TFT(s) 302a-302c as a source electrical potential difference. The sampling circuit driving signals 306a and 306b inputted through the sampling circuit drive signal line 306 from the data-line drive circuit 101 similarly shown in drawing 1 are inputted into each TFT(s) 302a-302c as gate voltage. Moreover, also in a sampling circuit 301, sampling circuit driving signal 306a impressed to N channel mold TFT302a as gate voltage and sampling circuit driving signal 306b impressed to P channel mold TFT302b as gate voltage are reversal signals like the case of the above-mentioned precharge circuit 201 mutual. Therefore, in constituting a sampling circuit 301 from complementary-type TFT302c, sampling circuit driving signal 306a and at least two or more sampling circuit drive signal lines 306 for 306b are needed.

[0057] Next, the configuration and actuation of the precharge [inspection-cum-] circuit 201 with which liquid crystal equipment 200 was equipped are further explained to a detail.

[0058] (Precharge function of a precharge [inspection-cum-] circuit) First, drawing 4 is referred to and the precharge function by the precharge [inspection-cum-] circuit 201 at the time of the normal operation of liquid crystal equipment 200 is explained. In addition, drawing 4 is the timing chart of the various signals at the time of the normal operation of a precharge [inspection-cum-] circuit.

[0059] As shown in drawing 4 , the clock signal (CLX) which specifies the selection time amount t1 (dot frequency) per pixel is inputted into the shift register which the data-line drive circuit 101 has as criteria of a horizontal scanning, but if a transfer start signal (DX) is inputted, sequential supply of the transfer signals X1 and X2 and -- will be carried out from this shift register. In each horizontal scanning period, a precharge circuit driving signal (NRG) is supplied to the timing preceded with the input of such a transfer start signal (DX). While the clock signal (CLY) made into the criteria of a vertical scanning more specifically becomes high-level, after a picture signal (VID) inverts on the basis of the electrical-potential-difference central value (VID core) of a signal, a precharge circuit driving signal (NRG) is made high-level after the time amount t3 progress which is a margin until it carries out precharge from these polarity reversals. On the other hand, let a precharge signal (NRS) be the predetermined level of a picture signal (VID) and like-pole nature in a horizontal blanking interval corresponding to reversal of a picture signal (VID). Therefore, precharge is performed in the time amount t2 by which a precharge circuit driving signal (NRG) is made high-level. And let a precharge circuit driving signal (NRG) be a low level by making a margin after before, i.e., precharge, ends only time amount t4 rather than the time of a horizontal blanking interval expiring and an effective display period starting until a picture signal is written in into time amount t4. As mentioned above, in each horizontal blanking interval, the precharge [inspection-cum-] circuit 201 precedes a precharge signal (NRS) with a picture signal, and supplies it to two or more data lines 35.

[0060] (Checking feature of a precharge [inspection-cum-] circuit) Next, with reference to drawing 8 , the checking feature of the precharge [inspection-cum-] circuit 201 is explained from drawing 5 . In addition, drawing 5 (a) is the circuit diagram of the example of 1 configuration of the data-line drive circuit 101 in the condition of conducting shut down inspection of the data line, and the precharge [inspection-cum-] circuit 201, and drawing 5 (b) is the timing chart. Drawing 6 is the circuit diagram of the example of 1 configuration of the data-line drive circuit 101 in the condition of conducting shunt evaluation of the data line, and the precharge [inspection-cum-] circuit 201. Drawing 7 is other examples of a configuration of the data-line drive circuit 101, and the circuit diagram of the precharge [inspection-cum-] circuit 201. drawing 8 (a) -- being concerned -- others -- it is the circuit diagram of 1 sequence part of the shift register with which the example of a configuration was equipped, and drawing 8 (b) is the timing chart.

[0061] Especially with the gestalt of this operation, as shown in drawing 1 , the data-line drive circuit 101

and the sampling circuit 301 are established in the end side of two or more data lines 35, and the precharge [inspection-cum-] circuit 201 is established in the other end side of two or more data lines. Moreover, by drawing 7 , the pixel field located in the center of the data line is omitted from drawing 5 , and the circuitry by the side of the end of the data line and the circuitry by the side of the other end are shown. And at the time of inspection, TFT202 contained in the precharge [inspection-cum-] circuit 201 will be in an ON state, respectively, if a precharge circuit driving signal (NRG) is supplied to a gate electrode through the precharge circuit drive signal line 206, and the precharge signal (NRS) supplied to a drain electrode through the precharge signal line 204 is supplied from a source electrode as an inspection signal to the data line 35 at the time of inspection. Or the current which flows through the precharge signal line 204 is measured as an inspection current.

[0062] Therefore, it can carry out so that electrical property inspection of the predetermined class over TFT of the picture element part connected to each data line 35 located among these TFT(s)202 and TFT(s)302 of a sampling circuit 301, respectively or this etc. may be explained below using the switching operation of TFT202 of the precharge [inspection-cum-] circuit 201.

[0063] In addition, although the gestalt of this operation explains the case where the picture signal line 304 is formed in 6 juxtaposition corresponding to the picture signals VID1-VID6 by which 6 phase expansion was carried out, neither the number of phase expansions nor the number of the picture signal line 304 is restricted to this.

[0064] (1) As shown in drawing 5 and drawing 6 , the 1st inspection approach point ** and the data-line drive circuit 101 The shift register 303 of one sequence which carries out the sequential output of the transfer signal from each stage, After restricting the time amount die length of a transfer signal so that the transfer signal outputted almost simultaneously from two stages in a shift register 303 which adjoin each other may not lap mutually in time The case where it has the wave control circuit 307 outputted as a sampling circuit driving signal Qn (n= 1, 3 [2 and 3], --) is explained.

[0065] In this case, to the timing shown in drawing 5 (b), a shift register 303 will output a sequential transfer signal synchronizing with a clock signal CLX and its reversal signal, if start signal DX is inputted. In drawing 5 (a) and in the wave control circuit 307 The non-AND of an enable signal ENB1 and the transfer signal outputted from odd level is taken by the NAND circuit, and a wave is orthopedically operated further by the buffer circuit 308. On the other hand The non-AND of an enable signal ENB2 and the transfer signal outputted from even level is taken by the NAND circuit, a wave is orthopedically operated further by the buffer circuit 308, and the sequential output of the sampling circuit driving signal Qn (n= 1, 3 [2 and 3], --) which does not lap mutually in time is carried out. Thus, if the data-line drive circuit 101 is constituted, the situation where a picture signal and an inspection signal, and a precharge signal (NRS) will be supplied ranging over two or more data lines 35 corresponding to the time lap in the transfer signal which gets mixed up can be prevented. And if the precharge signal (NRS) and precharge circuit driving signal (NRG) which will be supplied to the precharge [inspection-cum-] circuit 201 if constituted in this way are the case where 1H reversal drive like the above-mentioned is not performed, respectively, one sequence is sufficient for them. moreover, if a precharge signal (NRS) is made into two sequences even when performing the above-mentioned 1H reversal drive, it is sufficient with one sequence a precharge circuit driving signal (NRG). Therefore, as compared with the case (refer to drawing 7) where a sampling circuit is driven by the data-line drive circuit based on the transfer signal of two or more sequences outputted from the shift register of two or more sequences mentioned later, the number of I/O wiring for a precharge signal or precharge circuit driving signals concerning the precharge [inspection-cum-] circuit 201 or input/output terminals can be reduced sharply. In addition, as shown in drawing 2 (3), to constitute TFT202 from a complementary type TFT, it is necessary to input the precharge circuit driving signal NRG and its reversal signal into each two gates of TFT202. In this case, the precharge circuit driving signal NRG and its reversal signal may be supplied through two precharge circuit drive signal lines 206, and are the interior of liquid crystal equipment 200, and you may make it generate a reversal signal from the precharge circuit driving signal NRG.

[0066] With the gestalt of this operation, since the shift register 303 and the wave control circuit 307 of one sequence be use, in order to conduct inspection which measure the current in the picture signal line 304, and be explain below every data line 35 (that is, a fault be discover in the unit of the data line), the number of sequences of a precharge circuit driving signal (NRG) or a precharge signal (NRS) be set up so that a degree type may be fill.

[0067] "The number of the data lines turned on in the number of sequences x coincidence of a number of picture signal sequences >= shift register"

Or if it inspects for every data line by the amperometry in the precharge signal line 204 like the 2nd below-

mentioned inspection approach instead of the amperometry in the picture signal line 304, the number of sequences of a precharge circuit driving signal (NRG) or a precharge signal (NRS) will be set up so that a degree type may be filled.

[0068] "The number of the data lines turned on in the number of sequences x coincidence of the number of sequences >= shift register of the number of sequences x precharge circuit driving signal of a precharge signal"

In addition, even when not filling these formulas, inspection (discovery of a fault) in the group unit which consists of two or more data lines is possible, and the purpose which discovers a defective in a production line simply and is not turned to degree processes, such as an erector degree, is attained. However, since analysis of a fault is very useful to an improvement of the rate of a defective in a subsequent manufacturing technology, it is very important for discovering a fault in the unit of the data line like the gestalt of this operation.

[0069] (1-1) disconnection of the data line, or open-circuit inspection -- in this case, as shown in drawing 5 (a), carry out normal operation of the data-line drive circuit 101 and the scanning-line drive circuit 104. two or more TFT202 [and] which can be set in the precharge circuit 202 -- the precharge signal (NRS) which has a predetermined electrical potential difference called 5V in the precharge signal line 204 is impressed, making a precharge circuit driving signal (NRG) high-level, making all into an ON state. namely, -- Then, the predetermined electrical potential difference impressed to the precharge signal line 204 is impressed to each data line 35 through TFT202 made into the ON state. And when each data line 35 and each picture signal line 304 are made into switch-on by carrying out sequential ON of two or more TFT301 which can be set to a sampling circuit 301 with the electrical potential difference impressed to each data line 35 by the sampling circuit driving signal Sn (n= 1, 2, --), a current flows on the picture signal line 304. Then, the current which flows on this picture signal line 304 is measured, and it compares with the reference current I obtained when the TFT30 grade of the picture element part connected to the data line 35 or this is in an all seems well. And if the measurement current is contained in the range of reference current I**epsilon (epsilon: permission or error range), to each data line 35, it can judge with there not being disconnection or an open circuit. Conversely, if it does not go into this range, to each data line 35, it can judge with there being disconnection or an open circuit.

[0070] In addition, in this example, since the total of the picture signal line 304 is even, if the electrical potential difference from which level differs by turns in order like H (high-level), L (low level), H, L, H, and L is impressed to these, it is 1 time and can inspect. If L, L, H, L, L, H, L, L, H, and the electrical potential difference from which level differs like -- are impressed once again after impressing to these H, H, L, H, H, L, H, H, L, and the electrical potential difference from which level differs like -- once temporarily, if the total of the picture signal line 304 is odd, inspection of these contents will be attained by total of two electrical-potential-difference impression.

[0071] (1-2) the shunt evaluation of the data line -- stop actuation of the scanning-line drive circuit 104 first in this case. and it is shown in drawing 6 -- as -- TFT302 of a sampling circuit 301 -- all -- an ON state -- carrying out (that is, start signal DX of a shift register 303 being made high-level) -- TFT202 of the precharge circuit 201 -- a predetermined electrical potential difference is impressed between the picture signal lines 304 which adjoin each other, making a precharge circuit driving signal (NRG) into a low level namely,, making all into an OFF state. While impressing the high-level electrical potential difference of 15V, specifically, the low-level electrical potential difference of 0V is impressed to the picture signal line 304 corresponding to a picture signal 1, 3, and VID 5 at the picture signal line 304 corresponding to a picture signal 2, 4, and VID 6. Then, although a predetermined electrical potential difference is impressed to the data line 35 from the picture signal line 304 through TFT302, since TFT202 is turned off altogether, the data line 35 which adjoins each other is insulated mostly mutually, and the current should not flow among these picture signal lines 304 that adjoin each other. Then, it compares with the reference current**i obtained when the current which flows between the picture signal lines 304 which adjoin each other is measured and data-line 35 grade is in an all seems well in this condition (close to about 0). And if the measurement current is contained in the range of reference current**i, to each data line 35, it can judge with there being no short circuit. Conversely, if it does not go into this range, to each data line 35, it can judge with there being a short circuit.

[0072] (1-3) leak inspection of TFT of a sampling circuit -- stop actuation of the scanning-line drive circuit 104 first in this case. and drawing 6 -- setting -- TFT302 of a sampling circuit 301 -- all -- an OFF state -- carrying out (that is, letting start signal DX of a shift register 303 be a low level) -- TFT202 of the precharge circuit 201 -- a predetermined electrical potential difference called 12V is impressed to the precharge signal

line 204, making a precharge circuit driving signal (NRG) high-level, making all into an ON state. namely, -- Then, although a predetermined electrical potential difference is impressed to the data line 35 from the precharge signal line 204 through TFT202, since all of TFT302 switch of a sampling circuit 301 are turned off, a current should not flow on the picture signal line 304 from the data line 35 with the predetermined electrical potential difference of the data line 35. Then, it compares with the reference current**i obtained when the current which flows on the picture signal line 304 is measured and the TFT302 grade of a sampling circuit 301 is in an all seems well in this condition (close to about 0). And if the measurement current is contained in the range of reference current**i, to each TFT302, it can judge with there being no leak. Conversely, if it does not go into this range, to each TFT302, it can judge with there being leak.
[0073] (1-4) leak inspection of TFT of a precharge circuit -- stop actuation of the scanning-line drive circuit 104 first in this case. and drawing 6 -- setting -- TFT302 of a sampling circuit 301 -- all -- an ON state -- carrying out (that is, start signal DX of a shift register being made high-level) -- TFT202 of the precharge circuit 201 -- a predetermined electrical potential difference called 12V is impressed to the precharge signal line 204, making a precharge circuit driving signal (NRG) into a low level, making all into an OFF state. namely, -- Then, since TFT202 is turned off altogether, a current should not flow on the picture signal line 304 through TFT302 of the data line 35 and a sampling circuit 301 with the predetermined electrical potential difference of the precharge signal line 204. Then, it compares with the reference current**i obtained when the current which flows on the picture signal line 304 is measured and the TFT202 grade of the precharge circuit 201 is in an all seems well in this condition (close to about 0). And if the measurement current is contained in the range of reference current**i, to each TFT202, it can judge with there being no leak. Conversely, if it does not go into this range, to each TFT202, it can judge with there being leak.
[0074] (2) Explain the inspection approach when the 2nd inspection approach, next the data-line drive circuit 101 are equipped with shift register 303' of 4 sequence 8 phase which carries out the sequential output of the transfer signal from each stage as shown in drawing 7 for example, (namely, when it does not have the wave control circuit 307 as shown in drawing 5 and drawing 6).
[0075] In drawing 7 , each sequence of shift register 303' will output a sequential transfer signal (namely, the sampling circuit driving signals Q1 and Q2, --) synchronizing with a clock signal CLX1 and its reversal signal, a clock signal CLX2 and its reversal signal, a clock signal CLX3 and its reversal signal, a clock signal CLX4, and its reversal signal, respectively, if start signal DX is inputted.
[0076] In this case, the circuit part which constitutes one sequence (the sampling circuit driving signals Q1 and Q5, sequence which outputs Q9 --) of the shift register which can be set is extracted, it is shown in drawing 8 (a), and that timing chart is shown in drawing 8 (b). As shown in drawing 8 (b), the transfer signal (namely, the sampling circuit driving signals Q1, Q5, and Q9, --) outputted almost simultaneously from two stages which adjoin each other in each sequence of shift register 303' laps mutually in time. Moreover, the transfer signal (namely, the sampling circuit driving signals Q2, Q6, and Q10, --) similarly outputted almost simultaneously about other sequences from two stages which adjoin each other Lapping mutually in time, a transfer signal (namely, the sampling circuit driving signals Q3, Q7, and Q11, --) laps mutually in time, and a transfer signal (namely, the sampling circuit driving signals Q2, Q6, and Q10, --) laps mutually in time.
[0077] Therefore, when the data-line drive circuit 101 is constituted in this way, the configuration which does not drive to coincidence TFT302 of the sampling circuit 301 connected to the same picture signal line 304 by the sampling circuit driving signal Qi which laps mutually as shown in drawing 8 (b) is taken by restricting the number of the data lines 35 turned on in coincidence using the picture signal line 304 by which 6 phase expansion was carried out.
[0078] By the 2nd inspection approach, since shift register 303' of two or more sequences is used, in order to conduct inspection which measures the current in the precharge signal line 204, and is explained below every data line 35 (that is, a fault is discovered in the unit of the data line), the number of sequences of a precharge circuit driving signal (NRG) or a precharge signal (NRS) is set up so that a degree type may be filled.
[0079] "The number of the data lines turned on in the number of sequences x(number [of a precharge circuit driving signal] of sequences x 2) >=(number [of a shift register] of sequences x 2) x coincidence of a precharge signal"
Therefore, in the example of a configuration shown in drawing 7 , a precharge circuit driving signal (NRG) is made into two sequences (NRG1 and NRG2), and a precharge signal (NRS) is made into four sequences (NRS1, NRS2, NRS3, and NRS4).
[0080] In addition, even when not filling the above-mentioned formula, also by measuring the current in the picture signal line 304 like the 1st inspection approach mentioned above, inspection (discovery of a fault) in

the group unit which consist of two or more data lines be possible, and the purpose which discover a defective in a production line simply and be turn to degree processes, such as an erector degree, be attain.
[0081] Thus, although there are many I/O wiring for a precharge signal (NRS) or precharge circuit driving signals (NRG) and input/output terminals as compared with the case (refer to drawing 5 and drawing 6) where the shift register 303 of the one above-mentioned sequence is used when using shift register 303' of two or more sequences, the advantage in the gestalt of this operation to the Prior art by in addition making an inspection circuit and a precharge circuit serve a double purpose is not lost.
[0082] (2-1) disconnection of the data line, or open-circuit inspection -- carry out normal operation of the data-line drive circuit 101 and the scanning-line drive circuit 104 in drawing 7 in this case.
[0083] namely, -- and a predetermined electrical potential difference called 5V is impressed to the picture signal line 304, making a precharge circuit driving signal (NRG2) into a low level, making two or more TFT202 of NRG1 sequence in the precharge circuit 202 into an ON state (namely, -- being high-level in a precharge circuit driving signal (NRG1) -- carrying out), and making two or more TFT202 of NRG2 sequence into an OFF state first. Then, when each data line 35 and each picture signal line 304 are made into switch-on by carrying out sequential ON of two or more TFT301 which can set the predetermined electrical potential difference impressed to the picture signal line 304 to a sampling circuit 301 by the sampling circuit driving signal Sn (n= 1, 2, --), a current flows to the precharge signal line 204 corresponding to NRG1 sequence. Then, the existence of the disconnection or the open circuit in each data line 35 corresponding to NRG1 sequence can be judged by comparing with the reference current obtained when the current which flows to this precharge signal line 204 is measured and data-line 35 grade is in an all seems well.
[0084] Next, two or more TFT202 of NRG2 sequence in the precharge circuit 202 is made into an OFF state. (namely, a precharge circuit driving signal (NRG1) -- a low level -- carrying out) and namely, -- a predetermined electrical potential difference called 5V is impressed to the picture signal line 304, making high-level a precharge circuit driving signal (NRG2), making two or more TFT202 of NRG2 sequence into an ON state The existence of the disconnection or the open circuit in each data line 35 corresponding to NRG2 sequence can be judged like the case of NRG1 above-mentioned sequence.
[0085] (2-2) the shunt evaluation of the data line -- stop actuation of the scanning-line drive circuit 104 first in this case. and drawing 7 -- setting -- TFT302 of a sampling circuit 301 -- all -- an OFF state -- carrying out (that is, letting start signal DX of a shift register be a low level) -- TFT202 of the precharge circuit 201 -- a predetermined electrical potential difference is impressed between the precharge signal lines which adjoin each other, making high-level a precharge circuit driving signal (NRG1 and NRG2) namely,, making all into an ON state. While making it the high level of 12V, specifically, the precharge signal line 204 corresponding to the precharge signals NRS2 and NRS4 is made into the low level of 0V for the precharge signal line 204 corresponding to the precharge signals NRS1 and NRS3. Then, although a predetermined electrical potential difference is impressed to the data line 35 from the precharge signal line 204 through TFT202, since TFT302 is turned off altogether, the data line 35 which adjoins each other is insulated mostly mutually, and the current should not flow among these precharge signal lines 204 that adjoin each other. Then, the existence of the short circuit in each data line 35 can be judged by comparing with the reference current obtained when the current which flows between the precharge signal lines 204 which adjoin each other is measured and data-line 35 grade is in a normal state in this condition (close to about 0).
[0086] (2-3) leak inspection of TFT of a sampling circuit -- actuation of the scanning-line drive circuit 104 is suspended first in this case -- making -- drawing 7 -- setting -- TFT302 of a sampling circuit 301 -- let all be an OFF state (that is, let start signal DX of a shift register be a low level).
[0087] namely, -- and a predetermined electrical potential difference called 12V is impressed to the picture signal line 304, making a precharge circuit driving signal (NRG2) into a low level, making two or more TFT202 of NRG1 sequence in the precharge circuit 202 into an ON state (namely, -- being high-level in a precharge circuit driving signal (NRG1) -- carrying out), and making two or more TFT202 of NRG2 sequence into an OFF state first. Then, since all of TFT302 switch of a sampling circuit 301 are turned off, as for the predetermined electrical potential difference impressed to the picture signal line 304, a current should not flow to the precharge signal line 204 through the data line 35 and TFT202. then, every of the sampling circuit 301 corresponding to NRG1 sequence by comparing with the reference current obtained when the current which flows to the precharge signal line 204 is measured and the TFT302 grade of a sampling circuit 301 is in an all seems well in this condition (close to about 0) -- the existence of the leak in TFT302 can be judged.
[0088] Next, two or more TFT202 of NRG2 sequence in the precharge circuit 202 is made into an OFF state. (namely, a precharge circuit driving signal (NRG1) -- a low level -- carrying out) and namely, -- a

predetermined electrical potential difference called 12V is impressed to the picture signal line 304, making high-level a precharge circuit driving signal (NRG2), making two or more TFT202 of NRG2 sequence into an ON state The existence of each leak in TFT302 of the sampling circuit 301 corresponding to NRG2 sequence can be judged like the case of NRG1 above-mentioned sequence.
[0089] (2-4) leak inspection of TFT of a precharge circuit -- stop actuation of the scanning-line drive circuit 104 first in this case. and drawing 7 -- setting -- TFT302 of a sampling circuit 301 -- all -- an ON state -- carrying out (that is, start signal DX of a shift register being made high-level) -- TFT202 of the precharge circuit 201 -- a predetermined electrical potential difference called 12V is impressed to the picture signal line 304, making a precharge circuit driving signal (NRG1 and NRG2) into a low level, making all into an OFF state. namely, -- Then, since all of TFT202 switch of the precharge circuit 302 are turned off, as for the predetermined electrical potential difference impressed to the picture signal line 304, a current should not flow to the precharge signal line 204 through TFT302 and the data line 35. then, the thing compared with the reference current obtained when the current which flows to the precharge signal line 204 is measured and the TFT202 grade of the precharge circuit 201 is in a normal state in this condition (close to about 0) -- every of the precharge circuit 201 -- the existence of the leak in TFT202 can be judged.
[0090] As mentioned above, like the assembler to liquid crystal equipment 200, the precharge [inspection-cum-] circuit 201 in the gestalt of this operation has a checking feature in the case of inspection carried out a front, in front of a scribe process, etc., and has a precharge function in the case of the normal operation after the assembly to liquid crystal equipment 200. For this reason, as compared with the case where an inspection circuit and a precharge circuit are separately established in the circumference part of a substrate like before, the field on a substrate required in order to realize these two functions is notably small, and ends. Since it is not necessary to prepare in dedication the checking terminal and checking wiring which become unnecessary like before especially at the time of normal operation and I/O wiring for precharge, an input/output terminal, etc. can be used also [checking], it is very advantageous. Furthermore, since it has a bad influence on the liquid crystal equipment which the checking terminal which became unnecessary like before corroded, and incorporated a active-matrix substrate and this concerned or possibility that aggravation of a checking circuit or checking wiring will lead to the aggravation as the whole active-matrix substrate concerned and liquid crystal equipment is reduced, it is advantageous to a duplex.
[0091] (The whole liquid crystal equipment configuration) Next, the whole liquid crystal equipment example of a configuration equipped with the active-matrix substrate including the precharge [inspection-cum-] circuit 201 explained above is explained with reference to drawing 9 and drawing 10 . It is the top view where drawing 9 looked at liquid crystal equipment from the opposite substrate side here, and drawing 10 is the H-H' sectional view of drawing 9 .
[0092] In drawing 9 and drawing 10 , the sealant 52 which consists of a photo-setting resin as an example of the seal member which sticks both substrates in the perimeter of the screen-display field (namely, field of the liquid crystal equipment with which an image is actually displayed by the orientation change of state of the liquid crystal layer 50) specified with two or more pixel electrodes 11, and surrounds the liquid crystal layer 50 is formed along the screen-display field on the TFT array substrate 1. And between the screen-display fields and sealants 52 on the opposite substrate 2, the circumference abandonment 53 of protection-from-light nature is formed.
[0093] When put into the TFT array substrate 1 by the case of protection-from-light nature which opening was able to open behind corresponding to the screen-display field, the circumference abandonment 53 so that a screen-display field may not hide in the edge of opening of a case according to a manufacture error etc. That is, it is formed from the band-like protection-from-light nature ingredient which has width of face of 500 micrometers or more in the perimeter of a screen-display field so that the gap of about hundreds of micrometers to the case of the TFT array substrate 1 may be permitted, for example. Such circumference abandonment 53 of protection-from-light nature is formed in the opposite substrate 2 of sputtering and the photolithography which used metallic materials, such as Cr (chromium), nickel (nickel), and aluminum (aluminum), and etching. Or it is formed from ingredients, such as resin black which distributed carbon and Ti (titanium) to the photoresist.
[0094] The data-line drive circuit 101 and the mounting terminal 102 are formed in the field of the outside of a sealant 52 along the lower side of a screen-display field, and the scanning-line drive circuit 104 is established in the both sides of a screen-display field along with two sides of right and left of a screen-display field. Furthermore, two or more wiring 105 for connecting between the scanning-line drive circuits 104 established in the both sides of a screen-display field is formed in the surface of a screen-display field. Moreover, in at least one place of the corner section of the opposite substrate 2, the fish eye 106 which

consists of flow material for taking an electric flow between the TFT array substrate 1 and the opposite substrate 2 is formed. And the opposite substrate 2 with the almost same profile as a sealant 52 has fixed to the TFT array substrate 1 by the sealant 52 concerned.
[0095] Especially with the gestalt of this operation, the precharge [inspection-cum-] circuit 201 and the sampling circuit 301 are formed on the TFT array substrate 1 in the location which counters the circumference abandonment 53 of the protection-from-light nature formed in the opposite substrate 2, and the data-line drive circuit 101 and the scanning-line drive circuit 104 are formed on the narrow long and slender circumference part of the TFT array substrate 1 which does not face the liquid crystal layer 50.
[0096] The precharge [inspection-cum-] circuit 201 and a sampling circuit 301 are circuits of an alternating current drive fundamentally at the time of normal operation. For this reason, even if it establishes these precharge [inspection-cum-] circuits 201 and sampling circuits 301 in TFT array substrate 1 part which faces the liquid crystal layer 50 which was surrounded by the sealant 52 and pinched among both substrates, the problem of degradation of the liquid crystal layer 50 by direct-current-voltage impression is not produced. On the other hand, the data-line drive circuit 101 and the scanning-line drive circuit 104 are established in the circumference part of the TFT array substrate 1 which does not face the liquid crystal layer 50. Therefore, it can prevent beforehand that the direct-current-voltage component from the data-line drive circuit 101 or the scanning-line drive circuit 104 by which especially a direct-current drive is carried out leaks to the liquid crystal layer 50, and is impressed to it.
[0097] And it becomes easy to design these circumference circuits so that it can have allowances, the scanning-line drive circuit 104 and the data-line drive circuit 101 can be formed in the circumference part of the TFT array substrate 1 by forming the precharge [inspection-cum-] circuit 201 and a sampling circuit 301 and it may meet under the circumference abandonment 53 in this way at a specific specification.
[0098] With the gestalt of this operation, it is further prepared in the TFT array substrate 1 in the location which counters the circumference abandonment 53 also about the precharge signal line 204 and the precharge circuit drive signal line 206 (refer to drawing 1). In this case, at the time of normal operation, the precharge [inspection-cum-] circuit 201 does not produce the problem of degradation of the liquid crystal by direct-current-voltage impression, even if it forms such a precharge signal line 204 and the precharge circuit drive signal line 206 in TFT array substrate 1 part which faces the liquid crystal layer 50, since it is the circuit of an alternating current drive fundamentally. And in this way, if two kinds of I/O wiring is prepared in the bottom of the circumference abandonment 53, reduction of the display area in liquid crystal equipment will not be caused.
[0099] (Details configuration of liquid crystal equipment) Next, the concrete configuration of each picture element part of liquid crystal equipment etc. is explained with reference to drawing 14 from drawing 11 . It is the top view of TFT where drawing 11 is a top view of a picture element part where liquid crystal equipment adjoins each other, and drawing 12 constitutes the precharge [inspection-cum-] circuit of liquid crystal equipment here. Moreover, drawing 13 is the sectional view showing the A-A' cross section of drawing 11 , and the B-B' cross section of drawing 12 , and drawing 14 shows the C-C' cross section of drawing 11 , and is the sectional view which met the precharge signal line wired under circumference abandonment of liquid crystal equipment. In addition, in order to make each class and each part material into the magnitude of extent which can be recognized on a drawing, scales are made to have differed for each class or every each part material in drawing 13 and drawing 14 .
[0100] As shown in the top view of drawing 11 , in the screen-display field, two or more pixel electrodes 11 are arranged in the shape of a matrix on the TFT array substrate 1, adjoin each pixel electrode 11, and TFT30 (field enclosed with a broken line) is formed, and the scanning line 31 and capacity line 31' are prepared respectively along the boundary of the pixel electrode 11 in every direction at the data-line 35 list. Electrical installation of the data line 35 is carried out to the source field of the semi-conductor layer 32 through the contact hole 37, and it is controlled by the gate electrode which is a part of scanning line 31 in the channel field (the lower right of drawing 11 is a **** line part) of the semi-conductor layer 32. Electrical installation of the drain field of the semi-conductor layer 32 is carried out to the pixel electrode 11 through the contact hole 38. Moreover, in order to add storage capacitance to the pixel electrode 11, capacity line 31' is arranged. Storage capacitance forms as a dielectric the layer insulation layer (for example, gate insulating layer mentioned later) between 1st storage capacitance electrode 32' installed from the drain field of the semi-conductor layer 32, and said capacity line (2nd storage capacitance electrode) 31'. In addition, when forming capacity line 31' with the polish recon film etc. at the same process as the scanning line, it is good to carry out electrical installation through the constant potential line 501 and contact hole 502 which consist of low resistance metal metallurgy group silicide, such as aluminum formed at the same process as

the data line. By taking such a configuration, low resistance-ization of capacity line 31' is realizable. Moreover, if the constant potential line 501 is installed from the power source supplied to the circumference circuit prepared around a screen-display field as shown in drawing 11 , and it is made to wire the field of the circumference abandonment 53, the miniaturization of liquid crystal equipment is realizable by it becoming unnecessary to prepare the external input terminal of dedication, and forming wiring in the field which was dead space conventionally which is called the circumference abandonment 53 further.

[0101] Moreover, as shown in the top view of drawing 12 , in the precharge [inspection-cum-] circuit 201, the precharge signal line 204, the precharge circuit drive signal line 206, and the data line 35 are arranged in parallel. Electrical installation of the precharge signal line 204 is carried out to each source field of TFT202 through each contact hole 37", and electrical installation of the data line 35 is carried out to each drain field of TFT202 through each contact hole 38." Moreover, opposite arrangement of the precharge circuit drive signal line 206 is carried out through gate dielectric film as a gate electrode of TFT202 at the channel part which connects these source fields and drain fields.

[0102] As shown in the A-A' cross-section part of drawing 11 in the sectional view of drawing 13 , liquid crystal equipment is set to a picture element part. The insulating layer 41 between the 1st layer by which the laminating was carried out to the TFT array substrate 1 list on it, the semi-conductor layer 32, the gate insulating layer 33, the scanning line 31 (gate electrode), Between the 2nd layer, between an insulating layer 42, the data line 35 (source electrode), and the 3rd layer, it has an insulating layer 43, the pixel electrode 11, and the orientation film 12, and TFT30 is formed for every pixel. Moreover, in the picture element part, liquid crystal equipment equips the opposite substrate 2 list which consists of a glass substrate with the common electrode 21, the orientation film 22, and light-shielding film 23 by which the laminating was carried out on it, and is further equipped with the liquid crystal layer 50 pinched among both these substrates.

[0103] An insulating layer 43 consists of silicate glass film, such as NSG, PSG, BSG, and BPSG, a silicon nitride film, an oxidation silicone film, etc. between an insulating layer 42 and the 3rd layer between an insulating layer 41 and the 2nd layer between the 1st layer, respectively. The pixel electrode 11 consists of an opaque ingredient with high reflection factors, such as transparent conductive thin films, such as for example, ITO film (indium Tin oxide film), and aluminum. The orientation film 12 and 22 consists of organic thin films, such as for example, a polyimide thin film. The common electrode 21 consists of ITO film etc., and it goes across it all over the opposite substrate 2, and it is formed. The light-shielding film 23 is formed in the predetermined field which counters TFT30, is formed from a metallic material, resin black, etc. like the above-mentioned circumference abandonment 53, and has functions other than the protection from light to the semi-conductor layer 32 of TFT30, such as improvement in contrast, and color mixture prevention of color material. The liquid crystal layer 50 consists of liquid crystal which was formed when liquid crystal was enclosed with the space surrounded by the sealant 52 (refer to drawing 9 and drawing 10) between the TFT array substrate 1 and the opposite substrate 2 by vacuum suction etc., for example, mixed the pneumatic liquid crystal of a kind or some kinds. Sealants 52 are adhesives which consist of a photo-setting resin or thermosetting resin, and the spacer for making distance between both substrates into a predetermined value is mixed.

[0104] TFT30 is equipped with the source field 34 formed in the gate insulating layer 33 which insulates the semi-conductor layer 32 in which a channel is formed of the electric field from the scanning line 31 (gate electrode) and the scanning line 31, and the scanning line 31 and the semi-conductor layer 32, and the semi-conductor layer 32, the data line 35 (source electrode), and the drain field 36 formed in the semi-conductor layer 32. One to which it corresponds of two or more pixel electrodes 11 is connected to the drain field 36. The source field 34 and the drain field 36 are formed by doping the object for the N type of predetermined concentration, or the dopant for P type to the semi-conductor layer 32 like the after-mentioned according to whether the channel of N type or P type is formed.

[0105] The semi-conductor layer 32 which constitutes TFT30 is formed by performing annealing treatment and making the thickness of about 500-2000A carry out solid phase growth after forming the a-Si (amorphous silicon) film for example, on the insulating layer 41 between the 1st layer as a substrate. In the case of TFT30 of a P channel mold, said semi-conductor layer 32 is doped by the ion implantation which used the dopant of V group elements, such as Sb (antimony), As (arsenic), and P (Lynn). Moreover, in the case of TFT30 of an N channel mold, the source field 34 and the drain field 36 are formed by doping by the ion implantation which used the dopant of III group elements, such as B (boron), Ga (gallium), and In (indium). Moreover, when setting TFT30 to TFT of an N channel mold with LDD (Lightly Doped Drain Structure) structure, a low concentration dope field is formed in the part which adjoins a channel side among

the source field 34 and the drain field 36, respectively by the dopant of V group elements, such as P (Lynn), and, similarly a high concentration dope field is formed by the dopant of V group elements, such as P (Lynn). Moreover, when referred to as TFT30 of a P channel mold, the source field 34 and the drain field 36 are formed using the dopant of III group elements, such as B (boron). In addition, TFT30 is good also as TFT of offset structure, and good also as TFT of a self aryne mold. Moreover, the N channel mold TFT which can be written in a high speed is used for TFT30 for pixel switching in many cases.

[0106] Thus, since the liquid crystal equipment of the gestalt of this operation can be mostly formed by the P channel mold TFT and the N channel mold TFT at the same process on the TFT array substrate 1 which forms TFT30 for pixel switching, as shown in drawing 9 , it can form the data-line drive circuit 101 and the circumference circuit of scanning-line drive circuit 104 grade on the same substrate as a pixel at the periphery of the outside of a screen-display field. Thereby, it becomes unnecessary to carry out external [of the drive circuit], and becomes very advantageous to the miniaturization of cost and liquid crystal equipment.

[0107] The gate insulating layer 33 forms and obtains the thermal oxidation film with a comparatively thin thickness of about 300-1500A by oxidizing the semi-conductor layer 32 thermally with the temperature of about 900-1300 degrees C. Or in order to prevent the camber of the substrate by heat, an oxidation silicone film and a silicon nitride film may be formed on said thermal oxidation film, and the multilayer gate insulating layer 33 may be formed.

[0108] After the scanning line 31 (gate electrode) deposits the polish recon film with a reduced pressure CVD method etc., it is formed of a photolithography process, an etching process, etc. Or it may be formed from metal alloy film, such as refractory metal film metallurgy group silicide film, such as W (tungsten), Mo (molybdenum), and Ta (tantalum). in this case, it also becomes possible to omit a part or all of a light-shielding film 23 by the protection-from-light nature which the metal membrane metallurgy group silicide film has if a light-shielding film 23 arranges the scanning line 31 (gate electrode) as the part or the light-shielding film which boils all and corresponds of a wrap field. In this case, there is an advantage which can prevent decline in the pixel numerical aperture by the lamination gap with the opposite substrate 2 and the TFT array substrate 1 especially.

[0109] The data line 35 (source electrode) may be formed from transparent conductive thin films, such as ITO film, like the pixel electrode 11. Or you may form by sputtering processing etc. from metal alloy film, such as low resistance metal metallurgy group silicide, such as aluminum (aluminum) deposited on the thickness of about 1000-5000A. If the data line 35 is formed by the high film of protection-from-light nature like aluminum (aluminum), substitution of the light-shielding film 23 in which the data line 35 was formed on the opposite substrate is attained, and there is an advantage which can prevent decline in the pixel numerical aperture by the lamination gap with the opposite substrate 2 and the TFT array substrate 1 also in this case.

[0110] Moreover, the contact hole 37 for carrying out electrical installation of the source field 34 of a semi-conductor layer to the data line 35 is punctured by the insulating layer 42 between the 2nd layer. Furthermore, the contact hole 38 to the drain field 36 of a semi-conductor layer is punctured by the insulating layer 43 between the 2nd correlation insulating layer 42 and the 3rd layer. Electrical installation of the pixel electrode 11 is carried out to the drain field 36 of a semi-conductor layer through the contact hole 38 to the drain field 36 of this semi-conductor layer. The above-mentioned pixel electrode 11 is formed in the top face of an insulating layer 43 between the 3rd layer constituted in this way.

[0111] TFT30 is adjoined and storage capacitance 70 is added to the pixel electrode 11, respectively. 1st storage capacitance electrode 32' more specifically [this storage capacitance 70] installed from the drain field 36 of the semi-conductor layer 32, insulating-layer 33' formed of the same process as the gate insulating layer 33, and the capacity line 31 formed of the same process as the scanning line 31 -- ' (the 2nd storage capacitance electrode) -- It consists of some of insulating layers 42 and 43 and pixel electrodes 11 which counter a list at capacity line 31' through the 2nd and the insulating layers 42 and 43 between the 3rd layer between the 2nd and the 3rd layer. Thus, since storage capacitance 70 is formed, even if duty ratio is small, a high definition display is enabled.

[0112] Next, as shown in the B-B' cross-section part (left-hand side of drawing) of drawing 12 in the sectional view of drawing 13 , TFT202 (refer to drawing 1) of the precharge [inspection-cum-] circuit 201 is formed in liquid crystal equipment every data line 35. this -- TFT -- 202 -- more -- concrete -- a semi-conductor -- a layer -- 32 -- the same -- a process -- forming -- having -- a semi-conductor -- a layer -- 32 -- " -- the gate -- an insulating layer -- 33 -- the same -- a process -- forming -- having -- the gate -- an insulating layer -- 33 -- " -- and -- the scanning line -- 31 -- the same -- a process -- forming -- having -- precharge -- a

circuit -- a drive -- a signal line -- 206 -- having -- **** . a semi-conductor -- a layer -- 32 -- " -- **** -- TFT -- 30 -- a case -- the same -- a channel -- a field -- inserting -- the source -- a field -- 34 -- " -- and -- a drain -- a field -- 36 -- " -- preparing -- having -- the -- two -- a layer -- between -- an insulating layer -- 42 -- puncturing -- having had -- a contact hole -- 37 -- " -- and -- 38 -- " -- respectively -- leading -- a drain -- a field -- 36 -- " -- **** -- the data line -- 35 -- connecting -- having -- the source -- a field -- 34 -- " -- **** -- precharge -- a signal line -- 204 -- connecting -- having -- **** . And TFT202 with such layer structure is good to make it prepare on the TFT array substrate 1 in the location which counters the circumference abandonment 53 of the protection-from-light nature prepared in the opposite substrate 2. Since the field of the circumference abandonment 53 which was dead space conventionally can be used effectively by this, the miniaturization of liquid crystal equipment is realizable.

[0113] As shown in the sectional view of drawing 14 , in the location which counters the circumference abandonment 53, the precharge signal line 204 and the precharge circuit drive signal line 206 pass through the insulating-layer 42 between the 2nd layer on two or more scanning lines 31 upper part. and these precharge signal lines 204 and the precharge circuit drive signal line 206 were formed with metal thin films, such as aluminum in which almost all the parts were formed at the same process as the data line 35, -- low -- it is wiring [****]. Thus, since the field which was dead space conventionally by carrying out wiring formation of the precharge signal line 204 and the precharge circuit drive signal line 206 can be used effectively for the field of the circumference abandonment 53, the miniaturization of liquid crystal equipment is realizable.

[0114] In addition, although not illustrated from drawing 11 to drawing 14 , TFT302 (refer to drawing 1) of a sampling circuit 301 is constituted like TFT202 of the precharge [inspection-cum-] circuit 201, and is good to make it prepare on the TFT array substrate 1 in the location which counters the circumference abandonment 53 of the protection-from-light nature prepared in the opposite substrate 2. Thereby, since the occupancy area of the data-line drive circuit 101 is expandable, various functions liquid crystal equipment is realizable. Or it cannot be overemphasized that it is advantageous in case liquid crystal equipment is miniaturized.

[0115] In addition, although not shown in drawing 14 from drawing 11 , according to the exception of modes of operation, such as for example, TN (Twisted Nematic) mode, STN (super TN) mode, and D-STN (double-STN) mode, and the no MARI White mode / NOMA reeve rack mode, a polarization film, a phase contrast film, a polarizing plate, etc. are arranged in a predetermined direction at the side in which the incident light of the side in which the incident light of the opposite substrate 2 carries out incidence, and the TFT array substrate 1 carries out outgoing radiation, respectively. Moreover, the color filter of RGB, a die clo IKKU filter, a micro lens, etc. may be suitably formed in the opposite substrate 2. Furthermore, the protection-from-light layer which becomes from a refractory metal also at the TFT30 bottom may be prepared as indicated by the TFT array substrate 1 at JP,9-127497,A, JP,3-52611,B, JP,3-125123,A, JP,8-171101,A, etc.

[0116] The liquid crystal equipment of the gestalt of this operation is applicable to various kinds of liquid crystal ingredients (liquid crystal phase), a mode of operation, a liquid crystal array, the drive approach, etc.

[0117] (Electronic equipment) Next, the gestalt of operation of electronic equipment equipped with the liquid crystal equipment 100 in the gestalt of the operation explained to the detail above is explained with reference to drawing 18 from drawing 15 .

[0118] The outline configuration of the electronic equipment which equipped drawing 15 with liquid crystal equipment 100 and its drive circuit 1004 is shown first.

[0119] In drawing 15 , electronic equipment is constituted in preparation for the source 1000 of a display information output, the display information processing circuit 1002, the drive circuit 1004, liquid crystal equipment 100, and clock generation circuit 1008 list in the power circuit 1010. The source 1000 of a display information output outputs display information, such as a picture signal of a predetermined format, to the display information processing circuit 1002 based on the clock signal from the clock generation circuit 1008 including the tuning circuit which aligns and outputs memory, such as ROM (Read Only Memory), RAM (Random Access Memory), and an optical disk unit, and a picture signal. The display information processing circuit 1002 is constituted including various well-known processing circuits, such as magnification and a polarity-reversals circuit, a phase expansion circuit, a rotation circuit, a gamma correction circuit, and a clamping circuit, carries out sequential generation of the digital signal from the display information inputted based on the clock signal, and outputs it to the drive circuit 1004 with a clock signal CLK. The drive circuit 1004 drives liquid crystal equipment 100. A power circuit 1010 supplies a predetermined power source to each above-mentioned circuit. In addition, on the TFT array substrate which

constitutes liquid crystal equipment 100, the drive circuit 1004 may be carried and, in addition to this, the display information processing circuit 1002 may be carried.
[0120] Next, the example of the electronic equipment constituted in this way from drawing 16 by drawing 18 is shown, respectively.
[0121] In drawing 16 , an example slack liquid crystal projector 1100 of electronic equipment prepares three liquid crystal modules containing the liquid crystal equipment 100 with which the drive circuit 1004 mentioned above was carried on the TFT array substrate, and is constituted as a projector used as light valves 100R, 100G, and 100B for RGB, respectively. In a liquid crystal projector 1100, if incident light is emitted from the lamp unit 1102 of sources of the white light, such as a metal halide lamp, it will be divided into parts for Mitsunari R, G, and B corresponding to the three primary colors of RGB with the mirror 1106 of three sheets, and the dichroic mirror 1108 of two sheets, and will be led to the light valves 100R, 100G, and 100B corresponding to each color, respectively. Under the present circumstances, especially B light is drawn through the relay lens system 1121 which consists of the incidence lens 1122, a relay lens 1123, and an outgoing radiation lens 1124, in order to prevent the optical loss by the long optical path. And after a part for Mitsunari corresponding to the three primary colors modulated with light valves 100R, 100G, and 100B, respectively is again compounded with a dichroic prism 1112, it is projected on it by the screen 1120 as a color picture through a projector lens 1114.
[0122] In drawing 17 , other personal computers 1200 of the laptop type corresponding to example slack multimedia of electronic equipment (PC) are equipped with the body 1204 with which the keyboard 1202 was incorporated while it has liquid crystal equipment 100 mentioned above in the top covering case and they hold CPU, memory, a modem, etc. further.
[0123] moreover, as shown in drawing 18 , in the case of the liquid crystal equipment 100 which carries neither the drive circuit 1004 nor the display information processing circuit 1002 To TCP (Tape Carrier Package)1320 mounted on the polyimide tape 1322, IC1324 including the drive circuit 1004 or the display information processing circuit 1002 It is also possible to connect physically and electrically through the anisotropy electric conduction film prepared in the periphery of the TFT array substrate 1, and to carry out production, sale, use, etc. as liquid crystal equipment 100.
[0124] ****** equipped with the video tape recorder of a liquid crystal television, a viewfinder mold, or a monitor direct viewing type, the car navigation equipment, the electronic notebook, the calculator, the word processor, the engineering workstation (EWS), the cellular phone, the TV phone, POS terminal, and touch panel other than electronic equipment which were explained with reference to drawing 18 from drawing 16 above etc. is mentioned as an example of the electronic equipment shown in drawing 15 .
[0125]
[Effect of the Invention] According to the active-matrix substrate of this invention, a precharge [inspection-cum-] circuit Since the assembler to liquid crystal equipment has a checking feature in the case of inspection carried out a front, in front of a scribe process, etc. and has a precharge function in the case of the normal operation after the assembly to liquid crystal equipment As compared with the case where an inspection circuit and a precharge circuit are separately established in the circumference part of a substrate like before, a substrate top field required in order to realize these two functions is notably small, and ends. Since it is not necessary to prepare in dedication the checking terminal and checking wiring which become unnecessary like before especially at the time of normal operation and I/O wiring for precharge, an input/output terminal, etc. can be used also [checking], it is very advantageous.
[0126] According to liquid crystal equipment and electronic equipment of this invention, since various kinds of electrical property inspection is ensured, it is reliable, and a circumference circuit can be designed in a high specification with allowances, and reliable high definition actuation can be performed. Furthermore, the miniaturization of the whole equipment is also possible.
[0127] According to the inspection approach of the active-matrix substrate of this invention, various kinds of electric inspection, such as disconnection or open-circuit inspection, and shunt evaluation, can be ensured comparatively easily.

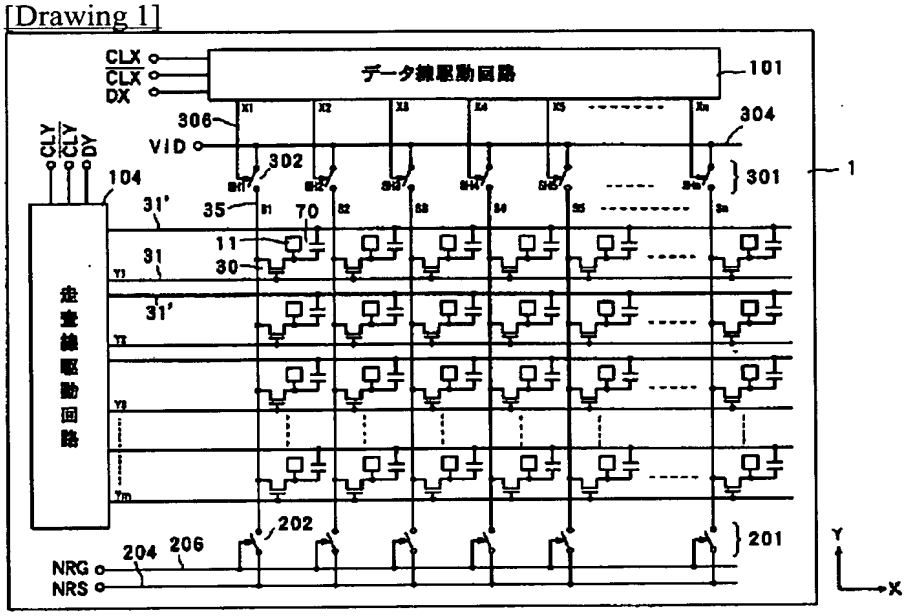
[Translation done.]

* NOTICES *

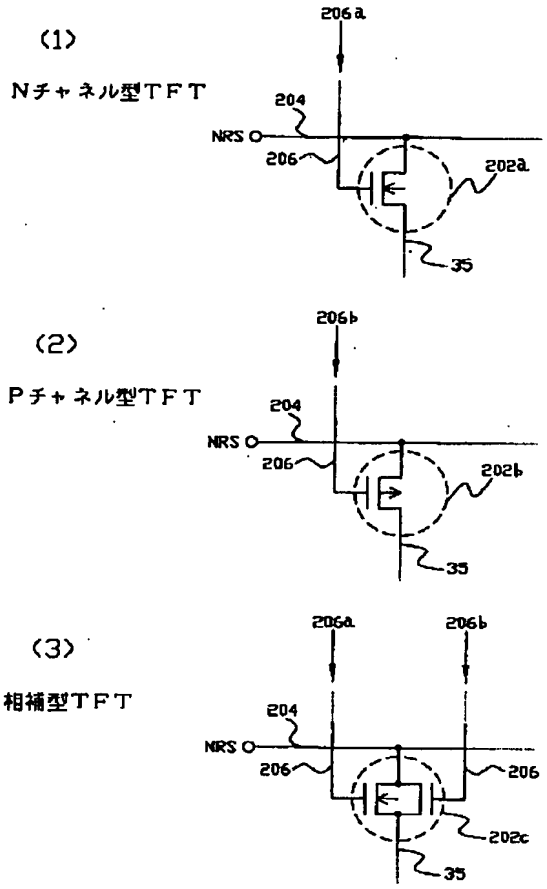
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

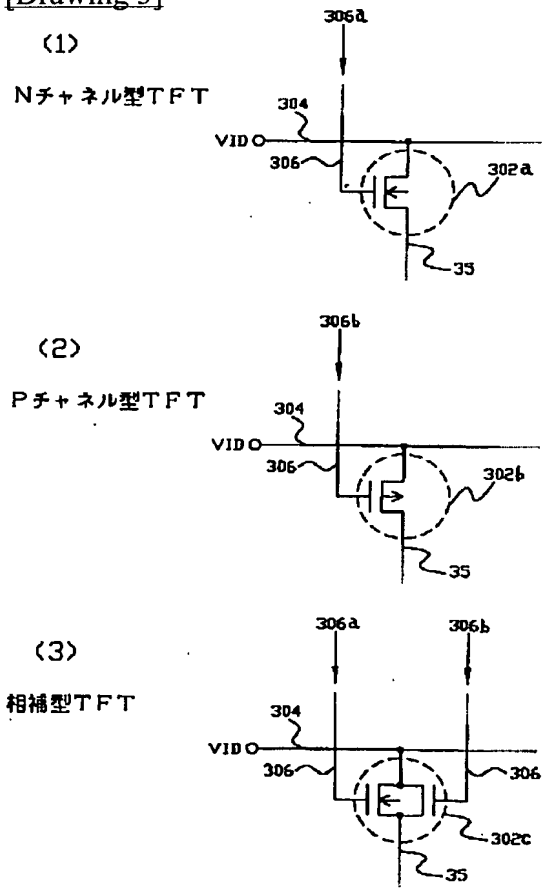
[Drawing 1]



[Drawing 2]


(1)
Nチャネル型TFT
206a
204
NRS
206
202a
35
(2)
Pチャネル型TFT
206b
204
NRS
206
202b
35
(3)
相補型TFT
206a
206b
204
NRS
206
206
202c
35

[Drawing 3]


(1)
Nチャネル型TFT
306a
304
VID
306
302a
35
(2)
Pチャネル型TFT
306b
304
VID
306
302b
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(3)
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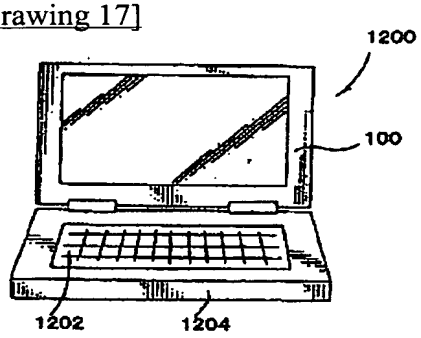
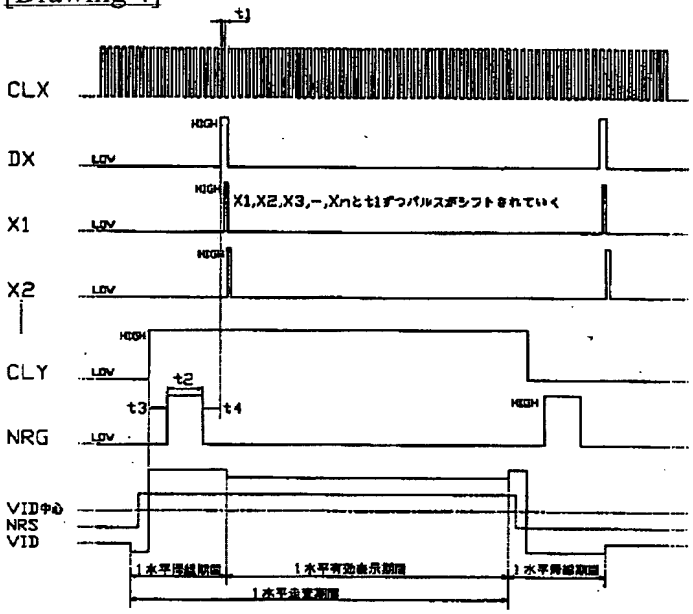
306b
304
VID
306
306
302c
35

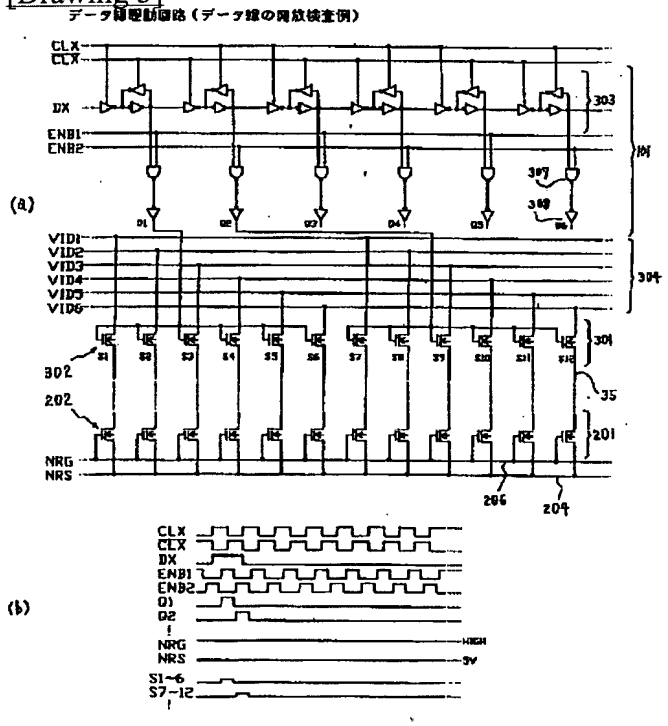
[Drawing 17]



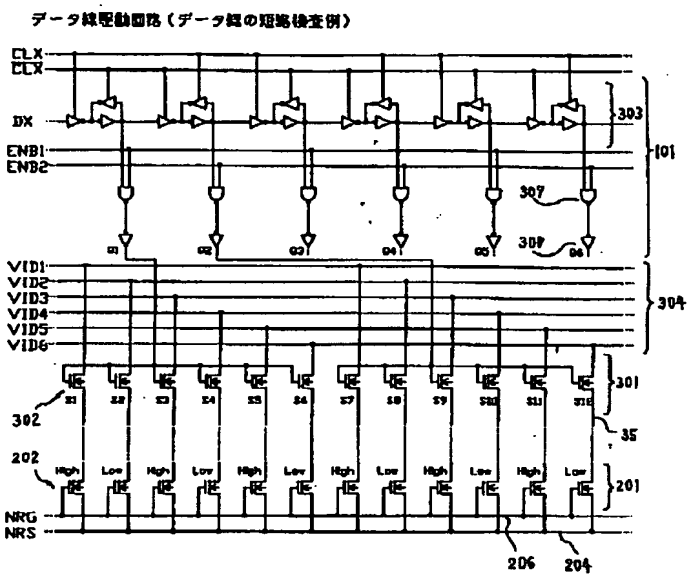
[Drawing 4]



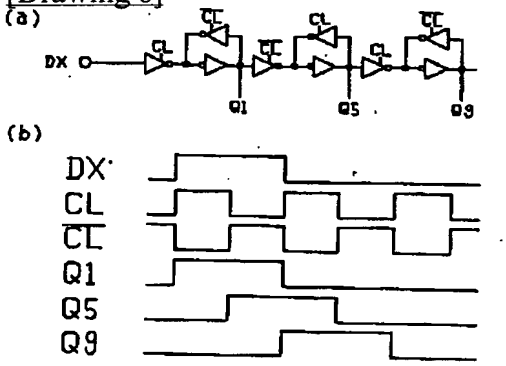
[Drawing 5]



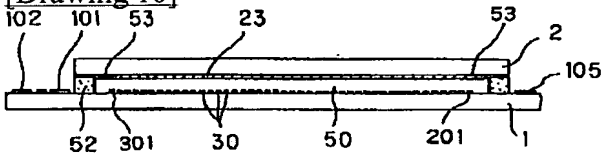
[Drawing 6]



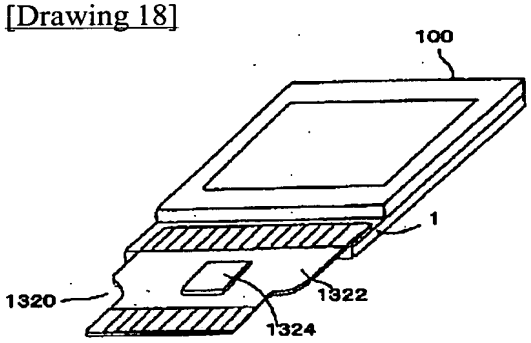
[Drawing 8]



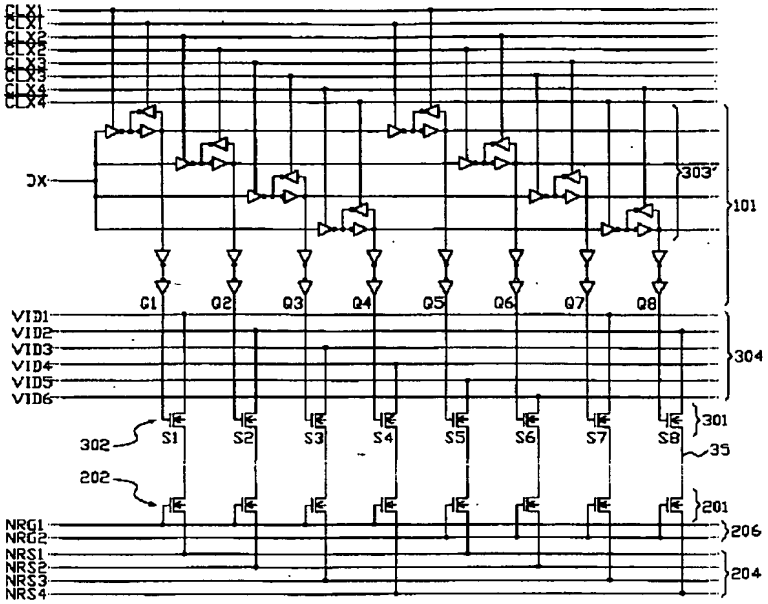
[Drawing 10]



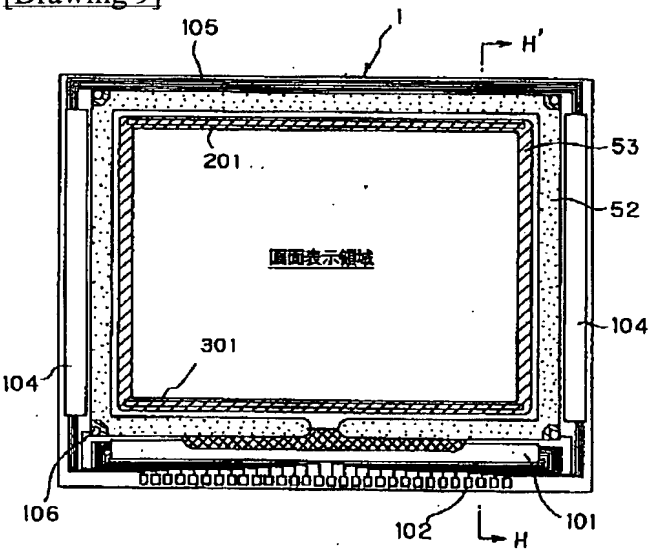
[Drawing 18]



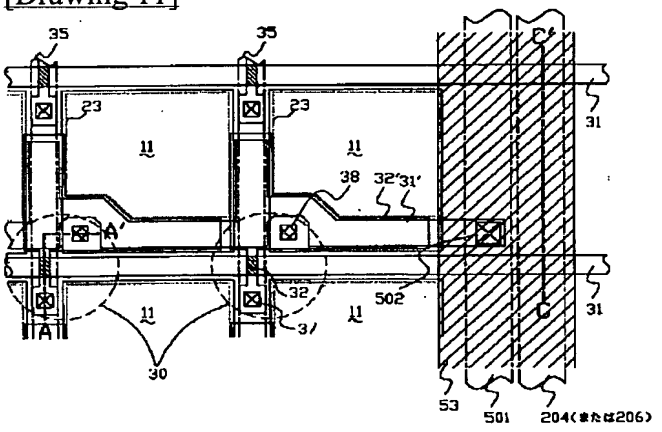
[Drawing 7]



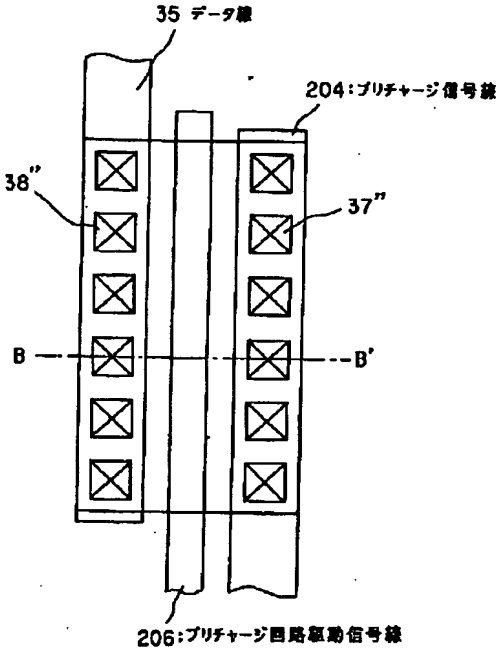
[Drawing 9]



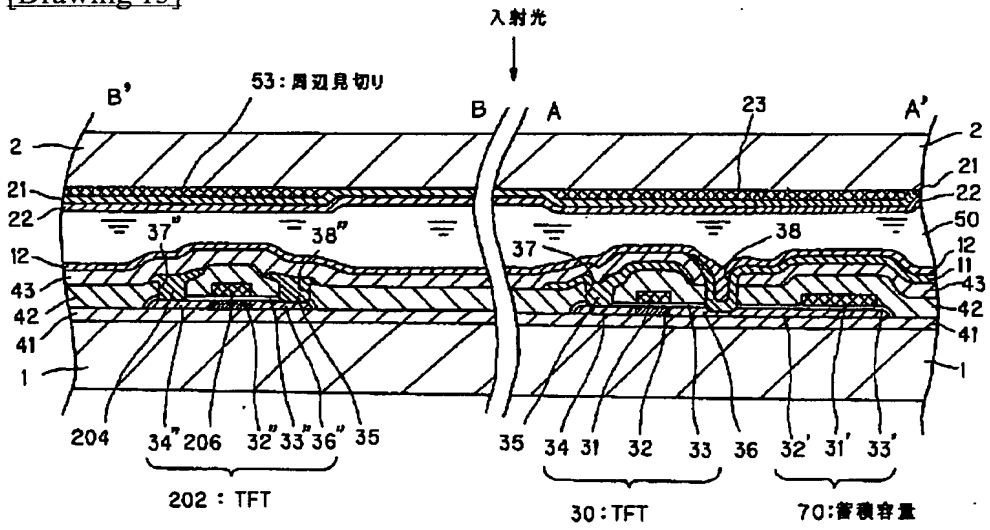
[Drawing 11]



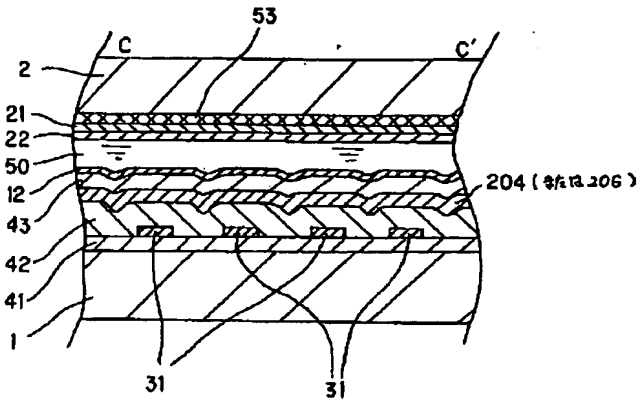
[Drawing 12]



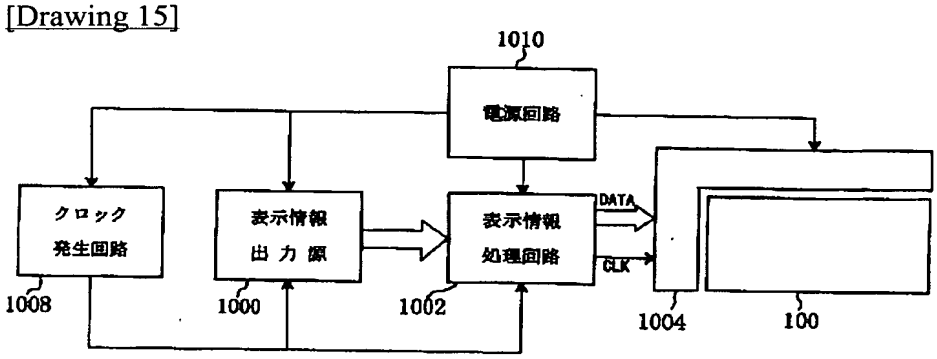
[Drawing 13]



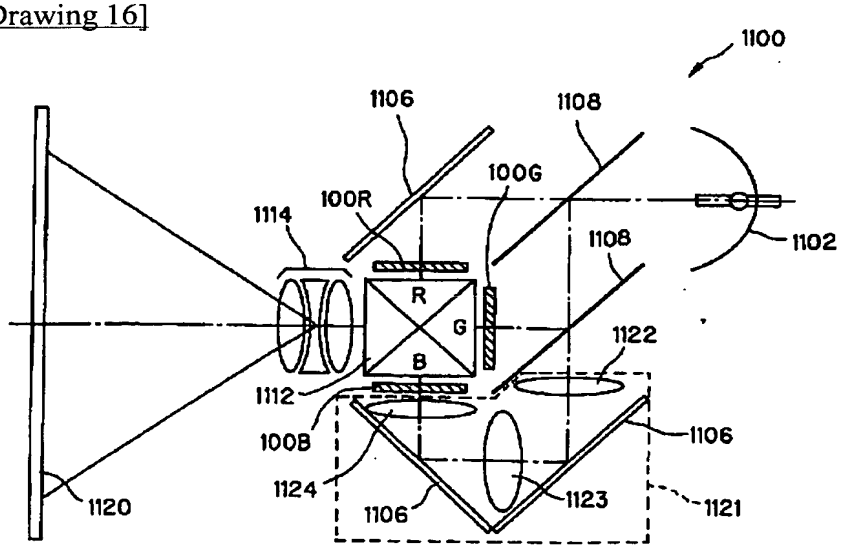
[Drawing 14]



[Drawing 15]



[Drawing 16]



[Translation done.]

* NOTICES *

CORRECTION OR AMENDMENT

[Kind of official gazette] Printing of amendment by the convention of 2 of Article 17 of Patent Law
[Section partition] The 2nd partition of the 6th section
[Publication date] December 18, Heisei 14 (2002. 12.18)

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[Date of Publication] October 8, Heisei 11 (1999. 10.8)
[Annual volume number] Open patent official report 11-2719
[Application number] Japanese Patent Application No. 10-76337
[The 7th edition of International Patent Classification]

G02F 1/136 500
1/1345
G09F 9/00 352

[FI]

G02F 1/136 500
1/1345
G09F 9/00 352

[Procedure revision]
[Filing Date] September 9, Heisei 14 (2002. 9.9)
[Procedure amendment 1]
[Document to be Amended] Specification
[Item(s) to be Amended] Claim
[Method of Amendment] Modification
[Proposed Amendment]
[Claim(s)]
[Claim 1] On a substrate,
Two or more scanning line and two or more data lines which carry out a phase crossover,
The scanning-line drive circuit which supplies a scan signal to said two or more scanning lines,
A picture signal supply means to be formed in the end side of two or more of said data lines, and to supply a picture signal to said two or more data lines,
Two or more picture element parts by which an active drive is carried out based on said scan signal with which it is prepared in the shape of a matrix, and is supplied through two or more of said scanning line and said two or more data lines, and said picture signal, respectively,
The active-matrix substrate characterized by having the precharge [inspection-cum-] circuit which precedes the precharge signal of a predetermined voltage level with said picture signal at the time of normal operation, and is supplied to said two or more data lines, respectively while being prepared in the other end side of two or more of said data lines and supplying an inspection signal to said two or more data lines at least, respectively at the time of inspection.
[Claim 2] Said precharge [inspection-cum-] circuit,
It is constituted including two or more precharge switches which carry out the switching output of the precharge signal inputted through a precharge signal line according to a precharge circuit driving signal, respectively, and are supplied to said two or more data lines as said inspection signal or said precharge

signal, respectively,
Said picture signal supply means,
A sampling circuit with two or more sampling switches which sample the picture signal inputted through a picture signal line according to a sampling circuit driving signal, respectively, and are supplied to said two or more data lines as said picture signal, respectively,
The active-matrix substrate according to claim 1 characterized by being constituted including the data-line drive circuit which supplies said sampling circuit driving signal to said two or more sampling switches, respectively.
[Claim 3] Said two or more precharge switches are active-matrix substrates according to claim 2 characterized by consisting of a thin film transistor by which said data line was connected to the source electrode, said precharge signal line was connected to the drain electrode, and said precharge circuit drive signal line was connected to the gate electrode, respectively.
[Claim 4] Said thin film transistor is a active-matrix substrate according to claim 3 characterized by consisting of one of an N channel mold transistor, a P channel mold transistor, and complementary transistors.
[Claim 5] Said data-line drive circuit,
The shift register of one sequence which carries out the sequential output of the transfer signal from each stage,
A active-matrix substrate given in any 1 term of claims 2-4 characterized by having the wave control circuit outputted as said sampling circuit driving signal after restricting the time amount die length of said transfer signal so that said transfer signal outputted almost simultaneously from two stages in this shift register which adjoin each other may not lap mutually in time.
[Claim 6] Said two or more picture element parts are constituted including the thin film transistor for an active drive, respectively,
Said precharge [inspection-cum-] circuit is a active-matrix substrate given in any 1 term of claims 1-5 characterized by consisting of same film as the thin film transistor of said picture element part including the thin film transistor formed in coincidence.
[Claim 7] A active-matrix substrate given in any 1 term of claims 1-6,
The substrate of another side of the substrates of said pair,
Liquid crystal equipment characterized by having said liquid crystal.
[Claim 8] The seal member which sticks the substrate of said pair in the perimeter of the screen-display field specified by said two or more picture element parts, and surrounds said liquid crystal,
It has further circumference abandonment of the protection-from-light nature formed along with the profile of said screen-display field at the substrate of said another side between said seal members and said screen-display fields,
Liquid crystal equipment according to claim 7 characterized by being prepared in the location where at least one side of the I/O wiring of said precharge [inspection-cum-] circuit and said precharge [inspection-cum-] circuit counters said circumference abandonment.
[Claim 9] Electronic equipment characterized by having liquid crystal equipment according to claim 8.
[Claim 10] It is the inspection approach of a active-matrix substrate given in claims 2-6,
(i) by measuring the current which impresses a predetermined electrical potential difference to said precharge signal line, and flows on said picture signal line, making said two or more precharge switches of all into an ON state, while carrying out normal operation of said data-line drive circuit Or, making into an ON state two or more precharge switches of all driven to coincidence with said precharge circuit driving signal, while carrying out normal operation of the (ii) aforementioned data-line drive circuit The inspection approach of the active-matrix substrate characterized by conducting disconnection or open-circuit inspection of two or more of said data lines by measuring the current which impresses a predetermined electrical potential difference to said picture signal line, and flows to said precharge signal line.
[Claim 11] It is the inspection approach of a active-matrix substrate given in claims 2-6,
(i) Making said two or more precharge switches of all into an OFF state, while making said all sampling switches into an ON state measuring the current which flows between the picture signal lines by which electrical installation is carried out to the data line which impresses a predetermined electrical potential difference and this adjoins each other between the picture signal lines by which electrical installation is carried out to the data line which adjoins each other -- or (ii) Making said two or more precharge switches of all into an ON state, while making said all sampling switches into an OFF state By measuring the current which flows between the precharge signal lines by which electrical installation is carried out to the data line

which impresses a predetermined electrical potential difference and this adjoins each other between the precharge signal lines by which electrical installation is carried out to the data line which adjoins each other The inspection approach of the active-matrix substrate characterized by conducting shunt evaluation of two or more of said data lines.
[Claim 12] It is the inspection approach of a active-matrix substrate given in claims 2-6,
(i) by measuring the current which impresses a predetermined electrical potential difference to said precharge signal line, and flows on said picture signal line, making said two or more precharge switches of all into an ON state, while making said all sampling switches into an OFF state Or, making into an ON state two or more precharge switches of all driven to coincidence with said precharge circuit driving signal, while making all the (ii) aforementioned sampling switches into an OFF state The inspection approach of the active-matrix substrate characterized by conducting leak inspection of said sampling switch by measuring the current which impresses a predetermined electrical potential difference to said picture signal line, and flows to said precharge signal line.
[Claim 13] It is the inspection approach of a active-matrix substrate given in claims 2-6,
(i) by measuring the current which impresses a predetermined electrical potential difference to said precharge signal line, and flows on said picture signal line, making said two or more precharge switches of all into an OFF state, while making said all sampling switches into an ON state Or, making said two or more precharge switches of all into an OFF state, while making all the (ii) aforementioned sampling switches into an ON state The inspection approach of the active-matrix substrate characterized by conducting leak inspection of said precharge switch by measuring the current which impresses a predetermined electrical potential difference to said picture signal line, and flows to said precharge signal line.
[Procedure amendment 2]
[Document to be Amended] Specification
[Item(s) to be Amended] 0009
[Method of Amendment] Modification
[Proposed Amendment]
[0009]
[Means for Solving the Problem] Two or more scanning line and two or more data lines which carry out a phase crossover on a substrate in order that the active-matrix substrate of this invention may solve the above-mentioned technical problem, The scanning-line drive circuit which supplies a scan signal to said two or more scanning lines, and a picture signal supply means to be formed in the end side of two or more of said data lines, and to supply a picture signal to said two or more data lines, Two or more picture element parts by which an active drive is carried out based on said scan signal with which it is prepared in the shape of a matrix, and is supplied through two or more of said scanning line and said two or more data lines, and said picture signal, respectively, It is prepared in the other end side of two or more of said data lines. While supplying an inspection signal to said two or more data lines at least, respectively at the time of inspection, it is characterized by having the precharge [inspection-cum-] circuit which precedes the precharge signal of a predetermined voltage level with said picture signal at the time of normal operation, and is supplied to said two or more data lines, respectively.
[Procedure amendment 3]
[Document to be Amended] Specification
[Item(s) to be Amended] 0010
[Method of Amendment] Modification
[Proposed Amendment]
[0010] According to this active-matrix substrate, a picture signal supply means to supply a picture signal to two or more data lines is formed in the end side of two or more data lines, and the precharge [inspection-cum-] circuit is established in the other end side of two or more data lines. Here, at the time of inspection, the inspection signal for performing electrical property inspection of a predetermined class to two or more data lines at least is supplied by the precharge [inspection-cum-] circuit, respectively. Therefore, electrical property inspection of predetermined classes, such as the disconnection or open-circuit inspection to the picture element part connected to each data line located among both, respectively or this, and shunt evaluation, can be conducted using a precharge [inspection-cum-] circuit, and a picture signal supply means.
[Procedure amendment 4]
[Document to be Amended] Specification
[Item(s) to be Amended] 0013

[Method of Amendment] Modification
[Proposed Amendment]
[0013] Moreover, the active-matrix substrate of this invention Said precharge [inspection-cum-] circuit It is constituted including two or more precharge switches which carry out the switching output of the precharge signal inputted through a precharge signal line according to a precharge circuit driving signal, respectively, and are supplied to said two or more data lines as said inspection signal or said precharge signal, respectively. A sampling circuit with two or more sampling switches which said picture signal supply means samples the picture signal inputted through a picture signal line according to a sampling circuit driving signal, respectively, and are supplied to said two or more data lines as said picture signal, respectively, It is characterized by being constituted including the data-line drive circuit which supplies said sampling circuit driving signal to said two or more sampling switches, respectively.
[Procedure amendment 5]
[Document to be Amended] Specification
[Item(s) to be Amended] 0014
[Method of Amendment] Modification
[Proposed Amendment]
[0014] According to this active-matrix substrate, two or more sampling switches which can be set to a sampling circuit are constituted so that the picture signal inputted through a picture signal line may be sampled according to a sampling circuit driving signal, respectively, and the data-line drive circuit is constituted so that a sampling circuit driving signal may be supplied to two or more sampling switches, respectively. Here, in a precharge circuit, according to a precharge circuit driving signal, a switching output is carried out by two or more precharge switches, and the precharge signal inputted through a precharge signal line is supplied to two or more data lines as an inspection signal, respectively at the time of inspection. Therefore, electrical property inspection of the predetermined class over each data line located, respectively between two or more precharge switches and two or more sampling switches can be conducted using a precharge switch, a sampling switch, and a data-line drive circuit.
[Procedure amendment 6]
[Document to be Amended] Specification
[Item(s) to be Amended] 0016
[Method of Amendment] Modification
[Proposed Amendment]
[0016] Moreover, the active-matrix substrate of this invention is characterized by said two or more precharge switches consisting of a thin film transistor by which said data line was connected to the source electrode, said precharge signal line was connected to the drain electrode, and said precharge circuit drive signal line was connected to the gate electrode, respectively.
[Procedure amendment 7]
[Document to be Amended] Specification
[Item(s) to be Amended] 0017
[Method of Amendment] Modification
[Proposed Amendment]
[0017] The thin film transistor which makes two or more precharge switches will be in an ON state, respectively, if a precharge circuit driving signal is supplied to a gate electrode through a precharge circuit drive signal line, and according to this active-matrix substrate, it supplies the precharge signal supplied to a drain electrode through a precharge signal line from a source electrode as a precharge signal as an inspection signal to the data line at the time of normal operation at the time of inspection.
[Procedure amendment 8]
[Document to be Amended] Specification
[Item(s) to be Amended] 0019
[Method of Amendment] Modification
[Proposed Amendment]
[0019] Moreover, the active-matrix substrate of this invention is characterized by said thin film transistor consisting of one of an N channel mold transistor, a P channel mold transistor, and complementary transistors.
[Procedure amendment 9]
[Document to be Amended] Specification
[Item(s) to be Amended] 0020

[Method of Amendment] Modification
[Proposed Amendment]
[0020] According to this active-matrix substrate, using TFT of an N channel mold transistor and a P channel mold transistor, i.e., a piece channel, and the switching operation of the precharge switch which consists of a complementary transistor constituted from an N channel mold transistor and a P channel mold transistor, electrical property inspection of a predetermined class can be ensured at the time of inspection, and precharge can be ensured at the time of normal operation.
[Procedure amendment 10]
[Document to be Amended] Specification
[Item(s) to be Amended] 0021
[Method of Amendment] Modification
[Proposed Amendment]
[0021] moreover , the active matrix substrate of this invention be characterize by to equip said data line drive circuit with the wave control circuit output as said sampling circuit driving signal after restrict the time amount die length of said transfer signal so that said transfer signal output almost simultaneously from each stage from two stages in the shift register and this shift register of one sequence which carry out the sequential output of the transfer signal which adjoin each other may not lap mutually in time .
[Procedure amendment 11]
[Document to be Amended] Specification
[Item(s) to be Amended] 0022
[Method of Amendment] Modification
[Proposed Amendment]
[0022] According to this active-matrix substrate, if the sequential output of the transfer signal is carried out from each stage of the shift register of one sequence, after the time amount die length of a transfer signal is restricted by the wave control circuit, it will be outputted by it as a sampling circuit driving signal, so that the transfer signal outputted almost simultaneously from this shift register may not lap mutually in time. Therefore, it originates in actuation of the sampling switch corresponding to the time lap in the transfer signal which gets mixed up, and the situation where a picture signal, an inspection signal, and a precharge signal will be supplied ranging over two or more data lines can be prevented. and if a precharge signal is made into two sequences even when it can be managed with one sequence and will perform the above-mentioned 1H reversal drive, if the precharge signal and precharge circuit driving signal which will be supplied to a precharge [inspection-cum-] circuit if constituted in this way are the case where 1H reversal drive like the above-mentioned is not performed, respectively, it is sufficient for them with one sequence a precharge circuit driving signal. Therefore, as compared with the case where a sampling switch is driven by the data-line drive circuit based on the transfer signal of two or more sequences outputted from the shift register of two or more sequences, the number of I/O wiring for a precharge signal or precharge circuit driving signals concerning a precharge [inspection-cum-] circuit or input/output terminals can be reduced sharply.
[Procedure amendment 12]
[Document to be Amended] Specification
[Item(s) to be Amended] 0023
[Method of Amendment] Modification
[Proposed Amendment]
[0023] Moreover, the active-matrix substrate of this invention is characterized by constituting said two or more picture element parts including the thin film transistor for an active drive, respectively, and said precharge [inspection-cum-] circuit consisting of same film as the thin film transistor of said picture element part including the thin film transistor formed in coincidence.
[Procedure amendment 13]
[Document to be Amended] Specification
[Item(s) to be Amended] 0024
[Method of Amendment] Modification
[Proposed Amendment]
[0024] Since it is formed in coincidence from the film with same thin film transistor in a picture element part and thin film transistor in a precharge [inspection-cum-] circuit according to this active-matrix substrate, manufacture of these thin film transistors is comparatively easy, and can attain low cost-ization of the whole equipment.

[Procedure amendment 14]
[Document to be Amended] Specification
[Item(s) to be Amended] 0025
[Method of Amendment] Modification
[Proposed Amendment]
[0025] The liquid crystal equipment of this invention is characterized by having the above-mentioned active-matrix substrate, the substrate of another side of the substrates of said pair, and said liquid crystal.
[Procedure amendment 15]
[Document to be Amended] Specification
[Item(s) to be Amended] 0026
[Method of Amendment] Modification
[Proposed Amendment]
[0026] According to this liquid crystal equipment, it has the active-matrix substrate of this invention mentioned above, and is constituted, and since various kinds of pre- electrical property inspection is ensured, it is as reliable as an assembler. Moreover, since neither I/O wiring only for an inspection circuit or inspection circuits nor an input/output terminal exists, the circumference circuit for performing normal operation, such as a precharge circuit, a sampling circuit, a data-line drive circuit, and a scanning-line drive circuit, can form with allowances.
[Procedure amendment 16]
[Document to be Amended] Specification
[Item(s) to be Amended] 0027
[Method of Amendment] Modification
[Proposed Amendment]
[0027] Moreover, the seal member which the liquid crystal equipment of this invention sticks the substrate of said pair in the perimeter of the screen-display field specified by said two or more picture element parts, and surrounds said liquid crystal, It has further circumference abandonment of the protection-from-light nature formed along with the profile of said screen-display field at the substrate of said another side between said seal members and said screen-display fields. At least one side of the I/O wiring of said precharge [inspection-cum-] circuit and said precharge [inspection-cum-] circuit is characterized by being prepared in the location which counters said circumference abandonment.
[Procedure amendment 17]
[Document to be Amended] Specification
[Item(s) to be Amended] 0028
[Method of Amendment] Modification
[Proposed Amendment]
[0028] According to this liquid crystal equipment, circumference abandonment of protection-from-light nature is formed along with the profile of a screen-display field at the 2nd substrate between the seal member and the screen-display field on the substrate (namely, opposite substrate) of another side. And either [at least] a precharge [inspection-cum-] circuit or its I/O wiring is prepared in one substrate in the location (henceforth "the bottom of circumference abandonment") which counters circumference abandonment. Here, a precharge [inspection-cum-] circuit is a circuit of an alternating current drive fundamentally at the time of normal operation. For this reason, while faces the liquid crystal which was surrounded by the seal member and pinched among both substrates, and even if it prepares a precharge [inspection-cum-] circuit, and its I/O wiring in a substrate part, the problem of degradation of the liquid crystal by direct-current-voltage impression is not produced. And in this way, by preparing a precharge [inspection-cum-] circuit, and its I/O wiring in the bottom of circumference abandonment, it can have allowances and for example, a scanning-line drive circuit and a data-line drive circuit can be formed in the circumference part of a narrow long and slender substrate.
[Procedure amendment 18]
[Document to be Amended] Specification
[Item(s) to be Amended] 0029
[Method of Amendment] Modification
[Proposed Amendment]
[0029] The electronic equipment of this invention is characterized by having the above-mentioned liquid crystal equipment.
[Procedure amendment 19]

[Document to be Amended] Specification
[Item(s) to be Amended] 0030
[Method of Amendment] Modification
[Proposed Amendment]
[0030] Since according to this electronic equipment it has liquid crystal equipment of this invention mentioned above and is constituted, the miniaturization is attained, high definition actuation is possible, and, moreover, it is reliable.
[Procedure amendment 20]
[Document to be Amended] Specification
[Item(s) to be Amended] 0031
[Method of Amendment] Modification
[Proposed Amendment]
[0031] The inspection approach of the active-matrix substrate of this invention (i) by measuring the current which impresses a predetermined electrical potential difference to said precharge signal line, and flows on said picture signal line, making said two or more precharge switches of all into an ON state, while carrying out normal operation of said data-line drive circuit Or, making into an ON state two or more precharge switches of all driven to coincidence with said precharge circuit driving signal, while carrying out normal operation of the (ii) aforementioned data-line drive circuit By measuring the current which impresses a predetermined electrical potential difference to said picture signal line, and flows to said precharge signal line, it is characterized by conducting disconnection or open-circuit inspection of two or more of said data lines.
[Procedure amendment 21]
[Document to be Amended] Specification
[Item(s) to be Amended] 0032
[Method of Amendment] Modification
[Proposed Amendment]
[0032] A predetermined electrical potential difference is impressed to a precharge signal line, making two or more precharge switches of all into an ON state according to the inspection approach of this active-matrix substrate, while carrying out normal operation of the (i) data-line drive circuit. Then, the predetermined electrical potential difference impressed to the precharge signal line is impressed to each data line through the precharge switch made into the ON state. And since it is turned on in the group unit which a sampling switch becomes from a data-line unit or two or more data lines, when each data line and each picture signal line are made into switch-on, a current flows on a picture signal line. Then, the current which flows on this picture signal line is measured, and if it compares with the reference current obtained when the picture element part connected to the data line or this is in a normal state, disconnection or an open circuit of the data line can be inspected in the group unit which consists of a data-line unit or two or more data lines.
[Procedure amendment 22]
[Document to be Amended] Specification
[Item(s) to be Amended] 0034
[Method of Amendment] Modification
[Proposed Amendment]
[0034] Moreover, the inspection approach of the active-matrix substrate of this invention (i) Making said two or more precharge switches of all into an OFF state, while making said all sampling switches into an ON state measuring the current which flows between the picture signal lines by which electrical installation is carried out to the data line which impresses a predetermined electrical potential difference and this adjoins each other between the picture signal lines by which electrical installation is carried out to the data line which adjoins each other -- or (ii) Making said two or more precharge switches of all into an ON state, while making said all sampling switches into an OFF state By measuring the current which flows between the precharge signal lines by which electrical installation is carried out to the data line which impresses a predetermined electrical potential difference and this adjoins each other between the precharge signal lines by which electrical installation is carried out to the data line which adjoins each other, it is characterized by conducting shunt evaluation of two or more of said data lines.
[Procedure amendment 23]
[Document to be Amended] Specification
[Item(s) to be Amended] 0035
[Method of Amendment] Modification

[Proposed Amendment]
[0035] A predetermined electrical potential difference is impressed between the picture signal lines by which electrical installation is carried out to the data line which adjoins each other, making two or more precharge switches of all into an OFF state according to the inspection approach of this active-matrix substrate, while making all the (i) sampling switches into an ON state. Then, although a predetermined electrical potential difference is impressed to the data line from a picture signal line through a sampling switch, since all precharge switches are turned off, the data line which adjoins each other is insulated mostly mutually, and the current should not flow between picture signal lines. Then, if it compares with the reference current obtained when the current which flows between the picture signal lines by which electrical installation is carried out to the data line which adjoins each other is measured and the data line etc. is in a normal state in this condition (close to about 0), the short circuit of the data line can be inspected in the group unit which consists of a data-line unit or two or more data lines.
[Procedure amendment 24]
[Document to be Amended] Specification
[Item(s) to be Amended] 0037
[Method of Amendment] Modification
[Proposed Amendment]
[0037] Moreover, the inspection approach of the active-matrix substrate of this invention (i) by measuring the current which impresses a predetermined electrical potential difference to said precharge signal line, and flows on said picture signal line, making said two or more precharge switches of all into an ON state, while making said all sampling switches into an OFF state Or, making into an ON state two or more precharge switches of all driven to coincidence with said precharge circuit driving signal, while making all the (ii) aforementioned sampling switches into an OFF state By measuring the current which impresses a predetermined electrical potential difference to said picture signal line, and flows to said precharge signal line, it is characterized by conducting leak inspection of said sampling switch.
[Procedure amendment 25]
[Document to be Amended] Specification
[Item(s) to be Amended] 0038
[Method of Amendment] Modification
[Proposed Amendment]
[0038] A predetermined electrical potential difference is impressed to a precharge signal line, making two or more precharge switches of all into an ON state according to the inspection approach of this active-matrix substrate, while making all the (i) sampling switches into an OFF state. Then, although a predetermined electrical potential difference is impressed to the data line from a precharge signal line through a precharge switch, since all sampling switches are turned off, a current should not flow on a picture signal line from the data line with the predetermined electrical potential difference of the data line. Then, if it compares with the reference current obtained when the current which flows on a picture signal line is measured and a sampling switch is in a normal state in this condition (close to about 0), leak of a sampling switch can be inspected in the group unit which consists of a data-line unit or two or more data lines.
[Procedure amendment 26]
[Document to be Amended] Specification
[Item(s) to be Amended] 0040
[Method of Amendment] Modification
[Proposed Amendment]
[0040] Moreover, the inspection approach of the active-matrix substrate of this invention (i) by measuring the current which impresses a predetermined electrical potential difference to said precharge signal line, and flows on said picture signal line, making said two or more precharge switches of all into an OFF state, while making said all sampling switches into an ON state Or, making said two or more precharge switches of all into an OFF state, while making all the (ii) aforementioned sampling switches into an ON state By measuring the current which impresses a predetermined electrical potential difference to said picture signal line, and flows to said precharge signal line, it is characterized by conducting leak inspection of said precharge switch.
[Procedure amendment 27]
[Document to be Amended] Specification
[Item(s) to be Amended] 0041
[Method of Amendment] Modification

[Proposed Amendment]
[0041] A predetermined electrical potential difference is impressed to a precharge signal line, making two or more precharge switches of all into an OFF state according to the inspection approach of this active-matrix substrate, while making all the (i) sampling switches into an ON state. Then, since all precharge switches are turned off, a current should not flow on a picture signal line through the data line and a sampling switch with the predetermined electrical potential difference of a precharge signal line. Then, if it compares with the reference current obtained when the current which flows on a picture signal line is measured and a precharge switch is in a normal state in this condition (close to about 0), leak of a precharge switch can be inspected in the group unit which consists of a data-line unit or two or more data lines.

[Translation done.]

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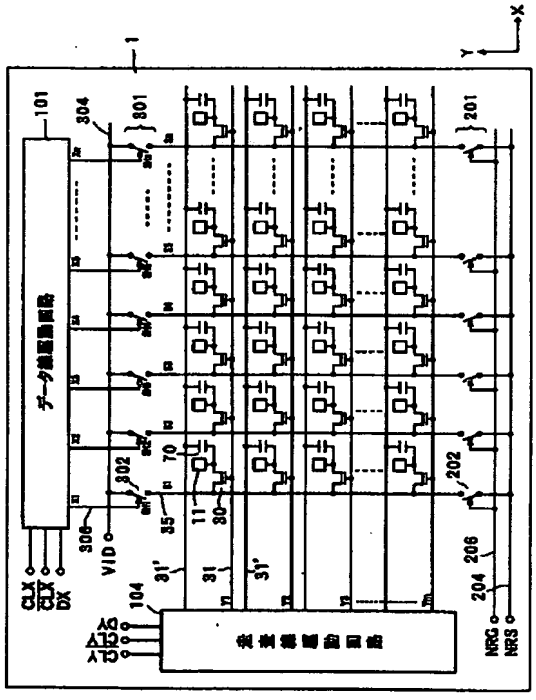
(54)【発明の名称】　アクティブマトリクス基板、液晶装置及び電子機器並びに該アクティブマトリクス基板の検査方法

(57)【要約】

【課題】　基板上に走査線、データ線、ＴＦＴ等が形成されてなり、液晶装置を構成するためのアクティブマトリクス基板において、検査機能とプリチャージ機能とを基板上の狭い領域で実現する。

【解決手段】　アクティブマトリクス基板は、複数のデータ線（３５）の一端側に設けられたデータ線駆動回路（１０１）と、その他端側に設けられており、液晶装置の組み立て工程前などに行われる検査時に、データ線に検査信号を供給すると共に、通常動作時に、データ線にプリチャージ信号を供給する検査兼プリチャージ回路（２０１）とを備える。



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【特許請求の範囲】

【請求項１】　一対の基板間に液晶が挟持されてなる液晶装置を構成するためのアクティブマトリクス基板であって、

前記一対の基板のうちの一方の基板上に、

相交差する複数の走査線及び複数のデータ線と、

前記複数の走査線に走査信号を供給する走査線駆動回路と、

前記複数のデータ線の一端側に設けられており、前記複数のデータ線に画像信号を供給する画像信号供給手段と、

マトリクス状に設けられており、前記複数の走査線及び前記複数のデータ線を介して供給される前記走査信号及び前記画像信号に基づいて夫々能動駆動される複数の画素部と、

前記複数のデータ線の他端側に設けられており、検査時に少なくとも前記複数のデータ線に検査信号を夫々供給すると共に通常動作時に所定電圧レベルのプリチャージ信号を前記画像信号に先行して前記複数のデータ線に夫々供給する検査兼プリチャージ回路とを備えたことを特徴とするアクティブマトリクス基板。

【請求項２】　前記検査兼プリチャージ回路は、

プリチャージ信号線を介して入力されるプリチャージ信号をプリチャージ回路駆動信号に応じて夫々スイッチング出力して前記検査信号又は前記プリチャージ信号として前記複数のデータ線に夫々供給する複数のプリチャージスイッチを含んで構成されており、

前記画像信号供給手段は、

画像信号線を介して入力される画像信号をサンプリング回路駆動信号に応じて夫々サンプリングして前記画像信号として前記複数のデータ線に夫々供給する複数のサンプリングスイッチを持つサンプリング回路と、

前記サンプリング回路駆動信号を前記複数のサンプリングスイッチに夫々供給するデータ線駆動回路とを含んで構成されていることを特徴とする請求項１に記載のアクティブマトリクス基板。

【請求項３】　前記複数のプリチャージスイッチは夫々、前記データ線がソース電極に接続され、前記プリチャージ信号線がドレイン電極に接続され、前記プリチャージ回路駆動信号線がゲート電極に接続された薄膜トランジスタからなることを特徴とする請求項２に記載のアクティブマトリクス基板。

【請求項４】　前記薄膜トランジスタは、Ｎチャネル型トランジスタ、Ｐチャネル型トランジスタ及び相補型トランジスタのうちの一つからなることを特徴とする請求項３に記載のアクティブマトリクス基板。

【請求項５】　前記データ線駆動回路は、

各段から転送信号を順次出力する１系列のシフトレジスタと、

該シフトレジスタにおける相隣接する二つの段から相前後して出力される前記転送信号が時間的に相互に重ならないように前記転送信号の時間長さを制限した後に前記サンプリング回路駆動信号として出力する波形制御回路とを備えたことを特徴とする請求項２から４のいずれか一項に記載のアクティブマトリクス基板。

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【請求項６】　前記複数の画素部は夫々、能動駆動用の薄膜トランジスタを含んで構成されており、

前記検査兼プリチャージ回路は、前記画素部の薄膜トランジスタと同じ膜から同時に形成された薄膜トランジスタを含んで構成されていることを特徴とする請求項１から５のいずれか一項に記載のアクティブマトリクス基板。

【請求項７】　請求項１から６のいずれか一項に記載のアクティブマトリクス基板と、

前記一対の基板のうちの他方の基板と、

前記液晶とを備えたことを特徴とする液晶装置。

【請求項８】　前記複数の画素部により規定される画面表示領域の周囲において前記一対の基板を貼り合わせて前記液晶を包囲するシール部材と、

前記シール部材と前記画面表示領域との間において前記画面表示領域の輪郭に沿って前記他方の基板に形成された遮光性の周辺見切りとを更に備えており、

前記検査兼プリチャージ回路及び前記検査兼プリチャージ回路の入出力配線のうちの少なくとも一方が前記周辺見切りに対向する位置に設けられたことを特徴とする請求項７に記載の液晶装置。

【請求項９】　請求項８に記載の液晶装置を備えたことを特徴とする電子機器。

【請求項１０】　請求項２から６に記載のアクティブマトリクス基板の検査方法であって、

(i)前記データ線駆動回路を通常動作させると共に前記複数のプリチャージスイッチ全てをオン状態としつつ、前記プリチャージ信号線に所定電圧を印加して前記画像信号線に流れる電流を測定することにより、或いは、(ii)前記データ線駆動回路を通常動作させると共に前記プリチャージ回路駆動信号により同時に駆動される複数のプリチャージスイッチ全てをオン状態としつつ、前記画像信号線に所定電圧を印加して前記プリチャージ信号線に流れる電流を測定することにより、前記複数のデータ線の開放又は断線検査を行うことを特徴とするアクティブマトリクス基板の検査方法。

【請求項１１】　請求項２から６に記載のアクティブマトリクス基板の検査方法であって、

(i)前記サンプリングスイッチ全てをオン状態とすると共に前記複数のプリチャージスイッチ全てをオフ状態としつつ、相隣接するデータ線に電気的接続される画像信号線の間に所定電圧を印加して該相隣接するデータ線に電気的接続される画像信号線間に流れる電流を測定することにより、或いは、(ii)前記サンプリングスイッチ全てをオフ状態とすると共に前記複数のプリチャージスイ

ッチ全てをオン状態としつつ、相隣接するデータ線に電気的接続されるプリチャージ信号線の間に所定電圧を印加して該相隣接するデータ線に電気的接続されるプリチャージ信号線間に流れる電流を測定することにより、前記複数のデータ線の短絡検査を行うことを特徴とするアクティブマトリクス基板の検査方法。

【請求項１２】　請求項２から６に記載のアクティブマトリクス基板の検査方法であって、

(i)前記サンプリングスイッチ全てをオフ状態とすると共に前記複数のプリチャージスイッチ全てをオン状態としつつ、前記プリチャージ信号線に所定電圧を印加して前記画像信号線に流れる電流を測定することにより、或いは、(ii)前記サンプリングスイッチ全てをオフ状態とすると共に前記プリチャージ回路駆動信号により同時に駆動される複数のプリチャージスイッチ全てをオン状態としつつ、前記画像信号線に所定電圧を印加して前記プリチャージ信号線に流れる電流を測定することにより、前記サンプリングスイッチのリーク検査を行うことを特徴とするアクティブマトリクス基板の検査方法。

【請求項１３】　請求項２から６に記載のアクティブマトリクス基板の検査方法であって、

(i)前記サンプリングスイッチ全てをオン状態とすると共に前記複数のプリチャージスイッチ全てをオフ状態としつつ、前記プリチャージ信号線に所定電圧を印加して前記画像信号線に流れる電流を測定することにより、或いは、(ii)前記サンプリングスイッチ全てをオン状態とすると共に前記複数のプリチャージスイッチ全てをオフ状態としつつ、前記画像信号線に所定電圧を印加して前記プリチャージ信号線に流れる電流を測定することにより、前記プリチャージスイッチのリーク検査を行うことを特徴とするアクティブマトリクス基板の検査方法。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、基板上に走査線やデータ線などの各種配線、薄膜トランジスタ（以下適宜、ＴＦＴと称する）などの駆動素子等が形成されており、対向基板との間に液晶を挟持することにより、アクティブマトリクス駆動方式の液晶装置等を構成するアクティブマトリクス基板、これを備えた液晶装置及び電子機器、並びにこのようなアクティブマトリクス基板における各種の電気特性検査方法の技術分野に属し、特に、プリチャージ回路及び検査回路などの周辺回路が基板上に形成される形式のアクティブマトリクス基板等の技術分野に属する。

【０００２】

【従来の技術】従来、ＴＦＴ駆動によるアクティブマトリクス駆動方式の液晶装置用のアクティブマトリクス基板においては、縦横に夫々配列された多数の走査線及びデータ線並びにこれらの各交点に対応して多数の画素電極やＴＦＴがガラス基板上に設けられるのが一般的である。このようなアクティブマトリクス基板は、対向基板とシール材により貼り合わされ且つ両基板間に液晶が封入されることにより、液晶装置を構成する。ここで特に、基板上に形成された各種配線等が断線や短絡していたり、或いはＴＦＴがリーク電流を生じていたりする不良なアクティブマトリクス基板は、当該アクティブマトリクス基板を液晶装置に組み立てる組み立て工程の前や、マザー基板上に複数形成された当該アクティブマトリクス基板を相互に切り離すスクライブ工程等の前に発見して、次工程に持ち込まないことが製造の効率化や低コスト化等の観点から望ましい。そこで、この種のアクティブマトリクス基板には、走査線駆動回路、データ線駆動回路、サンプリング回路、プリチャージ回路等に加えて、画面表示領域の周辺領域に形成される周辺回路の一つとして、液晶装置に組み立てられる前における当該アクティブマトリクス基板の電気特性検査を実行可能に構成された検査回路が設けられる場合がある。

【０００３】このような検査回路は例えば、複数のデータ線に夫々接続された複数のＴＦＴ等のスイッチング素子を備えており、また、これらのスイッチング素子を駆動するための検査用駆動信号やこれらのスイッチング素子等を介してデータ線に供給される検査信号を入力したり測定したりするための複数の検査用端子が基板上に専用に設けられ、更にこれらの検査用端子から検査回路までを結ぶ検査用配線が専用に設けられる。そして、例えば検査用端子にプローブを当てて所定電圧の検査用信号を入力しつつ検査用駆動信号を所定のタイミングで入力することにより、複数のデータ線の開放検査、断線検査、更にはサンプリングスイッチのリーク検査などの電気特性検査を各データ線の単位で或いは複数のデータ線のグループの単位で行えるように構成されている。

【０００４】他方、上述の周辺回路のうち、プリチャージ回路は特に、コントラスト比の向上、データ線の電位レベルの安定、表示画面上のラインむらの低減等を目的として、データ線に対し、データ線駆動回路から供給される画像信号に先行するタイミングで、プリチャージ信号を供給することにより、画像信号をデータ線に書き込む際の負荷を軽減する回路である。特に液晶を交流駆動するために通常行われるデータ線の電圧極性を所定周期で反転して駆動する、例えば走査線毎に液晶に印加する電圧を反転する、１Ｈ反転駆動方式においては、プリチャージ信号をデータ線に予め書き込んでおけば、画像信号をデータ線に書き込む際に必要な電気量を顕著に少なくできる。例えば、特開平７－２９５５２０号公報に、このようなプリチャージ回路の一例が開示されている。また、サンプリング回路は、高周波数の画像信号を各データ線に所定のタイミングで安定的に走査信号と同期して供給するために、画像信号をサンプリングする回路である。

【０００５】ここで、上述のように周辺回路を基板上に

備えた液晶装置の基板サイズが同じであれば、マトリクス状に配置された複数の画素部により規定される画面表示領域、即ち液晶装置上で実際に液晶の配向状態の変化により画像が表示される領域は、表示装置の基本的要請として大きい程よいとされている。従って、上述した検査回路やプリチャージ回路を含めて周辺回路は、画面表示領域の周囲に位置する基板の狭く細長い周辺部分に設けられるのが一般的である。

【０００６】

【発明が解決しようとする課題】しかしながら、上述した検査回路とプリチャージ回路との両方をアクティブマトリクス基板の周辺部分に設けようとすると、これらの回路を構成するＴＦＴの形成領域の確保や配線の引き回しなどが困難になるという問題点が生じる。即ち、走査線駆動回路やデータ線駆動回路に加えてサンプリング回路、プリチャージ回路、検査回路等までも前述の狭く細長い周辺部分に設けると、特定の仕様に沿うようにこれらの周辺回路を設計することが困難になるという問題点がある。

【０００７】特に検査回路を設ける場合に必要となる検査用端子については、プローブを立てること等との関係から、端子部の面積が例えば１００μｍ×１００μｍ程度にもなる。即ち、液晶装置の組み立て前に行われる検査のために、このような基板面上の貴重な領域が占められてしまうという問題点がある。加えて、このように基板面上に設けられた検査用端子は、通常Ａｌ（アルミニウム）等の金属薄膜などからなり、検査後の不使用時にもそのまま残されるため、製品化された後に腐食して液晶装置を不良化させたり、表示画像の品質を低下させかねないという問題点もある。

【０００８】本発明は上述した問題点に鑑みなされたものであり、基板上における比較的狭い領域を用いてプリチャージ機能と検査機能とを実現する液晶装置用のアクティブマトリクス基板、これを用いた液晶装置及び電子機器並びに該アクティブマトリクス基板の検査方法を提供することを課題とする。

【０００９】

【課題を解決するための手段】請求項１に記載のアクティブマトリクス基板は上記課題を解決するために、一対の基板間に液晶が挟持されてなる液晶装置を構成するためのアクティブマトリクス基板であって、前記一対の基板のうちの一方の基板上に、相交差する複数の走査線及び複数のデータ線と、前記複数の走査線に走査信号を供給する走査線駆動回路と、前記複数のデータ線の一端側に設けられており、前記複数のデータ線に画像信号を供給する画像信号供給手段と、マトリクス状に設けられており、前記複数の走査線及び前記複数のデータ線を介して供給される前記走査信号及び前記画像信号に基づいて夫々能動駆動される複数の画素部と、前記複数のデータ線の他端側に設けられており、検査時に少なくとも前記複数のデータ線に検査信号を夫々供給すると共に通常動作時に所定電圧レベルのプリチャージ信号を前記画像信号に先行して前記複数のデータ線に夫々供給する検査兼プリチャージ回路とを備えたことを特徴とする。

【００１０】請求項１に記載のアクティブマトリクス基板によれば、複数のデータ線に画像信号を供給する画像信号供給手段は、複数のデータ線の一端側に設けられており、検査兼プリチャージ回路は、複数のデータ線の他端側に設けられている。ここで、検査時には、少なくとも複数のデータ線に、所定種類の電気特性検査を行うための検査信号が、検査兼プリチャージ回路により夫々供給される。従って、検査兼プリチャージ回路と画像信号供給手段とを用いて、両者間に夫々位置する各データ線やこれに接続された画素部に対する開放又は断線検査や短絡検査などの所定種類の電気特性検査を行うことが出来る。

【００１１】他方、通常動作時には、所定電圧レベルのプリチャージ信号が、画像信号供給手段から供給される画像信号に先行して、検査兼プリチャージ回路により複数のデータ線に夫々供給される。そして、画像信号が複数のデータ線に画像信号供給手段により供給される。即ち、検査兼プリチャージ回路により、各データ線についてのプリチャージが行われ、プリチャージされた各データ線に対する画像信号の供給が画像信号供給手段により良好に行われることになる。

【００１２】以上のように、検査兼プリチャージ回路は、液晶装置への組み立て工程前やスクライブ工程前などに実施される検査の際には検査機能を持ち、液晶装置への組み立て後の通常動作の際にはプリチャージ機能を持つので、従来のように検査回路とプリチャージ回路とを別々に基板の周辺部分に設ける場合と比較して、これら二つの機能を実現するために必要な基板上領域が顕著に小さくて済む。

【００１３】請求項２に記載のアクティブマトリクス基板は請求項１に記載のアクティブマトリクス基板において、前記検査兼プリチャージ回路は、プリチャージ信号線を介して入力されるプリチャージ信号をプリチャージ回路駆動信号に応じて夫々スイッチング出力して前記検査信号又は前記プリチャージ信号として前記複数のデータ線に夫々供給する複数のプリチャージスイッチを含んで構成されており、前記画像信号供給手段は、画像信号線を介して入力される画像信号をサンプリング回路駆動信号に応じて夫々サンプリングして前記画像信号として前記複数のデータ線に夫々供給する複数のサンプリングスイッチを持つサンプリング回路と、前記サンプリング回路駆動信号を前記複数のサンプリングスイッチに夫々供給するデータ線駆動回路とを含んで構成されていることを特徴とする。

【００１４】請求項２に記載のアクティブマトリクス基板によれば、サンプリング回路における複数のサンプリ

ングスイッチは、画像信号線を介して入力される画像信号をサンプリング回路駆動信号に応じて夫々サンプリングするように構成されており、データ線駆動回路は、サンプリング回路駆動信号を複数のサンプリングスイッチに夫々供給するように構成されている。ここで、検査時には、プリチャージ回路において、プリチャージ信号線を介して入力されるプリチャージ信号は夫々、プリチャージ回路駆動信号に応じて、複数のプリチャージスイッチによりスイッチング出力されて、検査信号として複数のデータ線に夫々供給される。従って、プリチャージスイッチ、サンプリングスイッチ及びデータ線駆動回路を用いて、複数のプリチャージスイッチと複数のサンプリングスイッチとの間に夫々位置する各データ線に対する所定種類の電気特性検査を行うことが出来る。

【００１５】他方、通常動作時には、プリチャージ回路において、プリチャージ信号線を介して入力されるプリチャージ信号は夫々、プリチャージ回路駆動信号に応じて、複数のプリチャージスイッチによりスイッチング出力されて、プリチャージ信号として複数のデータ線に夫々供給される。そして、画像信号供給手段において、サンプリング回路駆動信号が複数のサンプリングスイッチにデータ線駆動回路により夫々供給されると、画像信号線を介して入力される画像信号は、サンプリング回路駆動信号に応じて、複数のサンプリングスイッチにより夫々サンプリングされて、画像信号として複数のデータ線に夫々供給される。即ち、検査兼プリチャージ回路により各データ線についてのプリチャージが行われ、プリチャージされた各データ線に対する画像信号の供給が画像信号供給手段により良好に行われることになる。

【００１６】請求項３に記載のアクティブマトリクス基板は請求項２に記載のアクティブマトリクス基板において、前記複数のプリチャージスイッチは夫々、前記データ線がソース電極に接続され、前記プリチャージ信号線がドレイン電極に接続され、前記プリチャージ回路駆動信号線がゲート電極に接続された薄膜トランジスタからなることを特徴とする。

【００１７】請求項３に記載のアクティブマトリクス基板によれば、複数のプリチャージスイッチをなす薄膜トランジスタは夫々、プリチャージ回路駆動信号線を介してゲート電極にプリチャージ回路駆動信号が供給されるとオン状態となり、プリチャージ信号線を介してドレイン電極に供給されるプリチャージ信号を、ソース電極からデータ線に対して、検査時には検査信号として、或いは通常動作時にはプリチャージ信号として供給する。

【００１８】従って、検査時には、これらの薄膜トランジスタのスイッチング動作を利用して、これらの薄膜トランジスタと複数のサンプリングスイッチとの間に夫々位置する各データ線に対する所定種類の電気特性検査を行うことが出来る。また通常動作時には、これらの薄膜トランジスタのスイッチング動作を利用して、各データ線についてのプリチャージが行われ、プリチャージされた各データ線に対する画像信号の供給が画像信号供給手段により良好に行われることになる。

【００１９】請求項４に記載のアクティブマトリクス基板は請求項３に記載のアクティブマトリクス基板において、前記薄膜トランジスタは、Ｎチャネル型トランジスタ、Ｐチャネル型トランジスタ及び相補型トランジスタのうちの一つからなることを特徴とする。

【００２０】請求項４に記載のアクティブマトリクス基板によれば、Ｎチャネル型トランジスタ、Ｐチャネル型トランジスタ、即ち片チャネルのＴＦＴや、Ｎチャネル型トランジスタ及びＰチャネル型トランジスタで構成する相補型トランジスタからなるプリチャージスイッチのスイッチング動作を利用して、検査時には所定種類の電気特性検査を確実に行え、通常動作時にはプリチャージを確実に行える。

【００２１】請求項５に記載のアクティブマトリクス基板は請求項２から４のいずれか一項に記載のアクティブマトリクス基板において、前記データ線駆動回路は、各段から転送信号を順次出力する１系列のシフトレジスタと、該シフトレジスタにおける相隣接する二つの段から相前後して出力される前記転送信号が時間的に相互に重ならないように前記転送信号の時間長さを制限した後に前記サンプリング回路駆動信号として出力する波形制御回路とを備えたことを特徴とする。

【００２２】請求項５に記載のアクティブマトリクス基板によれば、１系列のシフトレジスタの各段から転送信号を順次出力されると、該シフトレジスタから相前後して出力される転送信号が時間的に相互に重ならないように、波形制御回路により、転送信号の時間長さが制限された後、サンプリング回路駆動信号として出力される。従って、相前後する転送信号における時間的な重なりに対応したサンプリングスイッチの動作に起因して、画像信号、検査信号やプリチャージ信号が複数のデータ線に跨って供給されてしまう事態を未然に防げる。そして、このように構成すれば、検査兼プリチャージ回路に供給するプリチャージ信号やプリチャージ回路駆動信号は夫々、前述の如き１Ｈ反転駆動を行わない場合であれば１系列で済み、前述の１Ｈ反転駆動を行う場合でもプリチャージ信号を２系列にすれば（プリチャージ回路駆動信号は１系列のままで）足りる。従って、複数系列のシフトレジスタから出力される複数系列の転送信号に基づいてデータ線駆動回路によりサンプリングスイッチを駆動する場合と比較して、検査兼プリチャージ回路に係る、プリチャージ信号やプリチャージ回路駆動信号用の入出力配線や入出力端子の数を大幅に減らすことが出来る。

【００２３】請求項６に記載のアクティブマトリクス基板は請求項１から５のいずれか一項に記載のアクティブマトリクス基板において、前記複数の画素部は夫々、能動駆動用の薄膜トランジスタを含んで構成されており、

前記検査兼プリチャージ回路は、前記画素部の薄膜トランジスタと同じ膜から同時に形成された薄膜トランジスタを含んで構成されていることを特徴とする。

【００２４】請求項６に記載のアクティブマトリクス基板によれば、画素部における薄膜トランジスタと検査兼プリチャージ回路における薄膜トランジスタとは、同じ膜から同時に形成されているので、これらの薄膜トランジスタの製造は、比較的容易であり、装置全体の低コスト化を図れる。

【００２５】請求項７に記載の液晶装置は、請求項１から６のいずれか一項に記載のアクティブマトリクス基板と、前記一対の基板のうちの他方の基板と、前記液晶とを備えたことを特徴とする。

【００２６】請求項７に記載の液晶装置によれば、上述した本発明のアクティブマトリクス基板を備えて構成されており、組み立て工程前における各種の電気特性検査が確実に行われているために、信頼性が高い。また、検査回路や検査回路専用の入出力配線や入出力端子などが存在しないため、プリチャージ回路、サンプリング回路、データ線駆動回路、走査線駆動回路等の通常動作を行うための周辺回路が余裕を持って形成できる。

【００２７】請求項８に記載の液晶装置は、請求項７に記載の液晶装置において、前記複数の画素部により規定される画面表示領域の周囲において前記一対の基板を貼り合わせて前記液晶を包囲するシール部材と、前記シール部材と前記画面表示領域との間において前記画面表示領域の輪郭に沿って前記他方の基板に形成された遮光性の周辺見切りとを更に備えており、前記検査兼プリチャージ回路及び前記検査兼プリチャージ回路の入出力配線のうちの少なくとも一方が前記周辺見切りに対向する位置に設けられたことを特徴とする。

【００２８】請求項８に記載の液晶装置によれば、遮光性の周辺見切りは、他方の基板（即ち、対向基板）上でシール部材と画面表示領域との間において画面表示領域の輪郭に沿って、第２基板に形成されている。そして、検査兼プリチャージ回路及びその入出力配線のうちの少なくとも一方が、周辺見切りに対向する位置（以下、“周辺見切り下”という）において一方の基板に設けられている。ここで、検査兼プリチャージ回路は、通常動作時には基本的に交流駆動の回路である。このため、シール部材により包囲され両基板間に挟持された液晶に面する一方の基板部分に、検査兼プリチャージ回路やその入出力配線を設けても、直流電圧印加による液晶の劣化という問題は生じない。そして、このように周辺見切り下に、検査兼プリチャージ回路やその入出力配線を設けることで、例えば、走査線駆動回路やデータ線駆動回路を狭く細長い基板の周辺部分に余裕を持って形成することができる。

【００２９】請求項９に記載の電子機器は、請求項８に記載の液晶装置を備えたことを特徴とする。

【００３０】請求項９に記載の電子機器によれば、上述した本発明の液晶装置を備えて構成されるため、小型化が図られており高品位動作が可能であり、しかも信頼性が高い。

【００３１】請求項１０に記載のアクティブマトリクス基板の検査方法は、請求項２から６に記載のアクティブマトリクス基板を検査する検査方法であって、(i)前記データ線駆動回路を通常動作させると共に前記複数のプリチャージスイッチ全てをオン状態としつつ、前記プリチャージ信号線に所定電圧を印加して前記画像信号線に流れる電流を測定することにより、或いは、(ii)前記データ線駆動回路を通常動作させると共に前記プリチャージ回路駆動信号により同時に駆動される複数のプリチャージスイッチ全てをオン状態としつつ、前記画像信号線に所定電圧を印加して前記プリチャージ信号線に流れる電流を測定することにより、前記複数のデータ線の開放又は断線検査を行うことを特徴とする。

【００３２】請求項１０に記載のアクティブマトリクス基板の検査方法によれば、(i)データ線駆動回路を通常動作させると共に複数のプリチャージスイッチ全てをオン状態としつつ、プリチャージ信号線に所定電圧を印加する。すると、プリチャージ信号線に印加された所定電圧は、オン状態とされたプリチャージスイッチを介して各データ線に印加される。そして、サンプリングスイッチがデータ線単位又は複数のデータ線からなるグループ単位でオンされているので、各データ線と各画像信号線とが導通状態とされた時点で、画像信号線に電流が流れる。そこで、この画像信号線に流れる電流を測定して、データ線やこれに接続された画素部が正常状態にある場合に得られる基準電流と比較すれば、データ線単位又は複数のデータ線からなるグループ単位で、データ線の開放又は断線を検査できる。

【００３３】或いは、(ii)データ線駆動回路を通常動作させると共にプリチャージ回路駆動信号により同時に駆動される複数のプリチャージスイッチ全てをオン状態としつつ、画像信号線に所定電圧を印加する。すると、画像信号線に印加された所定電圧は、サンプリングスイッチによりサンプリングされて、各データ線に印加される。そして、プリチャージスイッチがオンされているため各データ線とプリチャージ信号線とが導通状態とされているので、各データ線に印加された電圧により、プリチャージ信号線に電流が流れる。そこで、このプリチャージ信号線に流れる電流を測定して、データ線等が正常状態にある場合に得られる基準電流と比較すれば、データ線単位又は複数のデータ線からなるグループ単位で、データ線の開放又は断線を検査できる。

【００３４】請求項１１に記載のアクティブマトリクス基板の検査方法は、請求項２から６に記載のアクティブマトリクス基板を検査する検査方法であって、(i)前記サンプリングスイッチ全てをオン状態とすると共に前記

複数のプリチャージスイッチ全てをオフ状態としつつ、相隣接するデータ線に電気的接続される画像信号線の間に所定電圧を印加して該相隣接するデータ線に電気的接続される画像信号線間に流れる電流を測定することにより、或いは、(ii)前記サンプリングスイッチ全てをオフ状態とすると共に前記複数のプリチャージスイッチ全てをオン状態としつつ、相隣接するデータ線に電気的接続されるプリチャージ信号線の間に所定電圧を印加して該相隣接するデータ線に電気的接続されるプリチャージ信号線間に流れる電流を測定することにより、前記複数のデータ線の短絡検査を行うことを特徴とする。

【００３５】請求項１１に記載のアクティブマトリクス基板の検査方法によれば、(i)サンプリングスイッチ全てをオン状態とすると共に複数のプリチャージスイッチ全てをオフ状態としつつ、相隣接するデータ線に電気的接続される画像信号線の間に所定電圧を印加する。すると、サンプリングスイッチを介して画像信号線からデータ線に所定電圧が印加されるが、プリチャージスイッチが全てオフされているため、相隣接するデータ線は相互にほぼ絶縁されており画像信号線間には電流は流れない筈である。そこで、この状態で、相隣接するデータ線に電気的接続される画像信号線間に流れる電流を測定して、データ線等が正常状態にある場合に得られる（ほぼ零に近い）基準電流と比較すれば、データ線単位又は複数のデータ線からなるグループ単位で、データ線の短絡を検査できる。

【００３６】或いは、(ii)サンプリングスイッチ全てをオフ状態とすると共に複数のプリチャージスイッチ全てをオン状態としつつ、相隣接するデータ線に電気的接続されるプリチャージ信号線の間に所定電圧を印加する。すると、プリチャージスイッチを介してプリチャージ信号線からデータ線に所定電圧が印加されるが、サンプリングスイッチが全てオフされているため、相隣接するデータ線は相互にほぼ絶縁されておりプリチャージ信号線間には電流は流れない筈である。そこで、この状態で、相隣接するデータ線に電気的接続されるプリチャージ信号線間に流れる電流を測定して、データ線が正常状態にある場合に得られる（ほぼ零に近い）基準電流と比較すれば、データ線単位又は複数のデータ線からなるグループ単位で、データ線の短絡を検査できる。

【００３７】請求項１２に記載のアクティブマトリクス基板の検査方法は、請求項２から６に記載のアクティブマトリクス基板を検査する検査方法であって、(i)前記サンプリングスイッチ全てをオフ状態とすると共に前記複数のプリチャージスイッチ全てをオン状態としつつ、前記プリチャージ信号線に所定電圧を印加して前記画像信号線に流れる電流を測定することにより、或いは、(ii)前記サンプリングスイッチ全てをオフ状態とすると共に前記プリチャージ回路駆動信号により同時に駆動される複数のプリチャージスイッチ全てをオン状態としつつ、前記画像信号線に所定電圧を印加して前記プリチャージ信号線に流れる電流を測定することにより、前記サンプリングスイッチのリーク検査を行うことを特徴とする。

【００３８】請求項１２に記載のアクティブマトリクス基板の検査方法によれば、(i)サンプリングスイッチ全てをオフ状態とすると共に複数のプリチャージスイッチ全てをオン状態としつつ、プリチャージ信号線に所定電圧を印加する。すると、プリチャージスイッチを介してプリチャージ信号線からデータ線に所定電圧が印加されるが、サンプリングスイッチが全てオフされているため、データ線の所定電圧によりデータ線から画像信号線に電流が流れない筈である。そこで、この状態で、画像信号線に流れる電流を測定して、サンプリングスイッチが正常状態にある場合に得られる（ほぼ零に近い）基準電流と比較すれば、データ線単位又は複数のデータ線からなるグループ単位で、サンプリングスイッチのリークを検査できる。

【００３９】或いは、(ii)サンプリングスイッチ全てをオフ状態とすると共にプリチャージ回路駆動信号により同時に駆動される複数のプリチャージスイッチ全てをオン状態としつつ、画像信号線に所定電圧を印加する。すると、サンプリングスイッチが全てオフされているため、画像信号線の所定電圧によりデータ線及びプリチャージスイッチを介してプリチャージ信号線に電流が流れない筈である。そこで、この状態で、プリチャージ信号線に流れる電流を測定して、サンプリングスイッチが正常状態にある場合に得られる（ほぼ零に近い）基準電流と比較すれば、データ線単位又は複数のデータ線からなるグループ単位で、サンプリングスイッチのリークを検査できる。

【００４０】請求項１３に記載のアクティブマトリクス基板の検査方法は、請求項２から６に記載のアクティブマトリクス基板を検査する検査方法であって、(i)前記サンプリングスイッチ全てをオン状態とすると共に前記複数のプリチャージスイッチ全てをオフ状態としつつ、前記プリチャージ信号線に所定電圧を印加して前記画像信号線に流れる電流を測定することにより、或いは、(ii)前記サンプリングスイッチ全てをオン状態とすると共に前記複数のプリチャージスイッチ全てをオフ状態としつつ、前記画像信号線に所定電圧を印加して前記プリチャージ信号線に流れる電流を測定することにより、前記プリチャージスイッチのリーク検査を行うことを特徴とする。

【００４１】請求項１３に記載のアクティブマトリクス基板の検査方法によれば、(i)サンプリングスイッチ全てをオン状態とすると共に複数のプリチャージスイッチ全てをオフ状態としつつ、プリチャージ信号線に所定電圧を印加する。すると、プリチャージスイッチが全てオフされているため、プリチャージ信号線の所定電圧によ

りデータ線及びサンプリングスイッチを介して画像信号線に電流が流れない筈である。そこで、この状態で、画像信号線に流れる電流を測定して、プリチャージスイッチが正常状態にある場合に得られる（ほぼ零に近い）基準電流と比較すれば、データ線単位又は複数のデータ線からなるグループ単位で、プリチャージスイッチのリークを検査できる。

【００４２】或いは、(ii)サンプリングスイッチ全てをオン状態とすると共に複数のプリチャージスイッチ全てをオフ状態としつつ、画像信号線に所定電圧を印加する。すると、サンプリングスイッチを介して画像信号線からデータ線に所定電圧が印加されるが、プリチャージスイッチが全てオフされているため、データ線の所定電圧によりデータ線からプリチャージ信号線に電流が流れない筈である。そこで、この状態で、プリチャージ信号線に流れる電流を測定して、プリチャージスイッチが正常状態にある場合に得られる（ほぼ零に近い）基準電流と比較すれば、データ線単位又は複数のデータ線からなるグループ単位で、プリチャージスイッチのリークを検査できる。

【００４３】本発明のこのような作用及び他の利得は次に説明する実施の形態から明らかにする。

【００４４】

【発明の実施の形態】以下、本発明の実施の形態を図面に基づいて説明する。

【００４５】（アクティブマトリクス基板の構成）本発明のアクティブマトリクス基板の実施の形態の構成について図１から図３に基づいて説明する。

【００４６】先ず、アクティブマトリクス基板全体の回路構成について、図１を参照して説明する。図１は、アクティブマトリクス基板に設けられた各種配線、周辺回路等の等価回路図である。

【００４７】図１において、アクティブマトリクス基板は、例えば石英基板、ハードガラス、シリコン基板等からなるＴＦＴアレイ基板１を備えている。ＴＦＴアレイ基板１上には、マトリクス状に設けられた複数の画素電極１１と、Ｘ方向に複数配列されており夫々がＹ方向に沿って伸びるデータ線３５と、Ｙ方向に複数配列されており夫々がＸ方向に沿って伸びる走査線３１と、各データ線３５と画素電極１１との間に夫々介在すると共に該間における導通状態及び非導通状態を、走査線３１を介して夫々供給される走査信号Ｙ１、Ｙ２、…、Ｙｍに応じて夫々制御するスイッチング素子の一例としての複数のＴＦＴ３０とが形成されている。またＴＦＴアレイ基板１上には、蓄積容量７０のための配線である容量線３１'が、走査線３１に沿ってほぼ平行に形成されており、画素電極１１に蓄積容量７０が付加されるようにする。これにより、寄生容量が原因で生じるフリッカ等の表示品位の劣化を防ぐことができる。尚、蓄積容量７０を形成するのに、前段の走査線３１を蓄積容量形成のための電極として用いてもよい。このような構成を採れば、容量線３１'を設ける必要がないため、画素開口率を向上させることができ、明るい液晶装置を提供することができる。ところで、データ線３５に書込まれる画像信号Ｓ１、Ｓ２、…、Ｓｎは、この順に線順次に供給しても良いし、相隣接する複数のデータ線３５同士に対してグループ毎に供給するようにしても良い。このように、相隣接する複数のデータ線３５を同時に駆動し、画像信号の位相をずらすことで、データ線駆動回路の駆動周波数を低減することが可能となり、回路の信頼性や低消費電力化が実現できる。

【００４８】ＴＦＴアレイ基板１上には更に、液晶装置２００（後述する）に組み立てられる前段階における検査時に、データ線３５やこれに接続された画素部のＴＦＴ３０等の開放又は断線検査、短絡検査などの各種の電気的検査を行う検査機能と、液晶装置２００の通常動作時に複数のデータ線３５に所定電圧レベルのプリチャージ信号ＮＲＳを画像信号Ｓ１、Ｓ２、…、Ｓｎに先行して夫々供給するプリチャージ機能との両機能を備えた検査兼プリチャージ回路２０１と、画像信号Ｓ１、Ｓ２、…、Ｓｎをサンプリングして複数のデータ線３５に夫々供給するサンプリング回路３０１と、データ線駆動回路１０１と、走査線駆動回路１０４とが形成されている。

【００４９】走査線駆動回路１０４は、外部制御回路から供給される電源、基準クロックＣＬＹ及びその反転クロック等に基づいて、所定タイミングで走査線３１（ゲート電極線）に走査信号Ｙ１、Ｙ２、…、Ｙｍをパルス的に線順次で印加する。

【００５０】データ線駆動回路１０１は、外部制御回路から供給される電源、基準クロックＣＬＸ及びその反転クロック等に基づいて、走査線駆動回路１０４が走査信号Ｙ１、Ｙ２、…、Ｙｍを印加するタイミングに合わせて、画像信号線３０４夫々について、データ線３５毎にサンプリング回路駆動信号ＳＨ１、ＳＨ２、…、ＳＨｎをサンプリング回路３０１にサンプリング回路駆動信号線３０６を介して所定タイミングで供給する。

【００５１】検査兼プリチャージ回路２０１は、スイッチング素子として、例えばＴＦＴ２０２を各データ線３５毎に備えており、プリチャージ信号線２０４がＴＦＴ２０２のドレイン又はソース電極に接続されており、プリチャージ回路駆動信号線２０６がＴＦＴ２０２のゲート電極に接続されている。そして、通常動作時には、プリチャージ信号線２０４を介して、外部電源からプリチャージ信号ＮＲＳを書き込むために必要な所定電圧の電源が供給され、プリチャージ回路駆動信号線２０６を介して、各データ線３５について画像信号Ｓ１、Ｓ２、…、Ｓｎに先行するタイミングでプリチャージ信号ＮＲＳを書き込むように、外部制御回路からプリチャージ回路駆動信号ＮＲＧが供給される。検査兼プリチャージ回路２０１は、好ましくは中間階調レベルの画像信号Ｓ

１、Ｓ２、…、Ｓｎに相当するプリチャージ信号ＮＲＳ（画像補助信号）を供給する。また、検査兼プリチャージ回路２０１は、検査時には、後述のように所定種類の電気的検査を実施すべく検査用の電圧をデータ線３５に印加したり、検査用の電流を流すことが可能なように構成されている。

【００５２】サンプリング回路３０１は、ＴＦＴ３０２を各データ線３５毎に備えており、画像信号線３０４がＴＦＴ３０２のソース電極に接続されており、サンプリング回路駆動信号線３０６がＴＦＴ３０２のゲート電極に接続されている。そして、画像信号線３０４を介して、画像信号Ｓ１、Ｓ２、…、Ｓｎが入力されると、これらをサンプリングする。即ち、サンプリング回路駆動信号線３０６を介してデータ線駆動回路１０１からサンプリング回路駆動信号ＳＨ１、ＳＨ２、…、ＳＨｎが入力されると、画像信号線３０４夫々について画像信号Ｓ１、Ｓ２、…、Ｓｎをデータ線３５に順次印加する。

【００５３】このように本実施の形態では、データ線３５を一本毎に選択するように構成されているが、データ線３５を複数本毎にまとめて同時選択するように構成してもよい。例えば、サンプリング回路３０１を構成するＴＦＴ３０２の書き込み特性及び画像信号の周波数に応じて、複数相（例えば、３相、６相、１２相、…）に相展開された画像信号Ｓ１、Ｓ２、…、Ｓｎを画像信号線３０４から供給して、これらをグループ毎に同時にサンプリングするように構成してもよい。この際、少なくとも相展開数だけ画像信号線３０４が必要なことは言うまでもない。

【００５４】次に、検査兼プリチャージ回路２０１及びサンプリング回路３０１を構成するＴＦＴ２０２及び３０２の具体的な回路構成について図２及び図３を参照して夫々説明する。尚、図２は、検査兼プリチャージ回路２０１のＴＦＴ２０２を構成する各種のＴＦＴを示す回路図であり、図３は、サンプリング回路３０１のＴＦＴ３０２を構成する各種のＴＦＴを示す回路図である。

【００５５】図２（１）に示すようにプリチャージ回路２０１のＴＦＴ２０２（図１参照）は、Ｎチャネル型ＴＦＴ２０２ａから構成されてもよいし、図２（２）に示すようにＰチャネル型ＴＦＴ２０２ｂから構成されてもよいし、図２（３）に示すようにＮチャネル型ＴＦＴ及びＰチャネル型ＴＦＴから成る相補型ＴＦＴ２０２ｃから構成されてもよい。なお、図２（１）から図２（３）において、図１に示したプリチャージ回路駆動信号線２０６を介して入力されるプリチャージ回路駆動信号２０６ａ、２０６ｂは、ゲート電圧として各ＴＦＴ２０２ａ～２０２ｃに入力される。同じく図１に示したプリチャージ信号線２０４を介して入力されるプリチャージ信号ＮＲＳは、ソース電圧として各ＴＦＴ２０２ａ～２０２ｃに入力される。Ｎチャネル型ＴＦＴ２０２ａにゲート電圧として印加されるプリチャージ回路駆動信号２０６ａと、Ｐチャネル型ＴＦＴ２０２ｂにゲート電圧として印加されるプリチャージ回路駆動信号２０６ｂとは、相互に反転信号である。従って、プリチャージ回路２０１を相補型ＴＦＴ２０２ｃで構成する場合には、プリチャージ回路駆動信号線２０６が少なくとも２本以上必要となる。このようにプリチャージ回路駆動信号線２０６が２本以上になる場合、画面表示領域の一方の側に集中して配線してもよいし、プリチャージ信号線２０４と組み合わせて、画面表示領域の両側から配線してもよい。或いは、例えば、各々の或いは複数の相隣接する相補型ＴＦＴ２０２ｃの手前でプリチャージ回路駆動信号２０６ａをインバータにより反転させて、プリチャージ回路駆動信号２０６ｂを形成してもよい。

【００５６】図３（１）に示すようにサンプリング回路３０１のＴＦＴ３０２（図１参照）は、Ｎチャネル型ＴＦＴ３０２ａから構成されてもよいし、図３（２）に示すようにＰチャネル型ＴＦＴ３０２ｂから構成されてもよいし、図３（３）に示すように相補型ＴＦＴ３０２ｃから構成されてもよい。なお、図３（１）から図３（３）において、図１に示した画像信号線３０４を介して入力される画像信号ＶＩＤは、ソース電圧として各ＴＦＴ３０２ａ～３０２ｃに入力される。同じく図１に示したデータ線駆動回路１０１からサンプリング回路駆動信号線３０６を介して入力されるサンプリング回路駆動信号３０６ａ、３０６ｂは、ゲート電圧として各ＴＦＴ３０２ａ～３０２ｃに入力される。また、サンプリング回路３０１においても、前述のプリチャージ回路２０１の場合と同様に、Ｎチャネル型ＴＦＴ３０２ａにゲート電圧として印加されるサンプリング回路駆動信号３０６ａと、Ｐチャネル型ＴＦＴ３０２ｂにゲート電圧として印加されるサンプリング回路駆動信号３０６ｂとは、相互に反転信号である。従って、サンプリング回路３０１を相補型ＴＦＴ３０２ｃで構成する場合には、サンプリング回路駆動信号３０６ａ、３０６ｂ用のサンプリング回路駆動信号線３０６が少なくとも２本以上必要となる。

【００５７】次に、液晶装置２００に備えられた検査兼プリチャージ回路２０１の構成及び動作について更に詳細に説明する。

【００５８】（検査兼プリチャージ回路のプリチャージ機能）先ず、図４を参照して、液晶装置２００の通常動作時における検査兼プリチャージ回路２０１によるプリチャージ機能について説明する。尚、図４は、検査兼プリチャージ回路の通常動作時における各種信号のタイミングチャートである。

【００５９】図４に示すように、データ線駆動回路１０１が有するシフトレジスタには、一画素当りの選択時間ｔ１（ドット周波数）を規定するクロック信号（ＣＬＸ）が水平走査の基準として入力されるが、転送スタート信号（ＤＸ）が入力されると、このシフトレジスタか

ら転送信号Ｘ１、Ｘ２、…が順次供給される。各水平走査期間において、このような転送スタート信号（ＤＸ）の入力に先行するタイミングで、プリチャージ回路駆動信号（ＮＲＧ）が供給される。より具体的には、垂直走査の基準とされるクロック信号（ＣＬＹ）がハイレベルとなると共に画像信号（ＶＩＤ）が信号の電圧中心値（ＶＩＤ中心）を基準として極性反転した後、この極性反転からプリチャージをするまでのマージンである時間ｔ３経過後に、プリチャージ回路駆動信号（ＮＲＧ）は、ハイレベルとされる。他方、プリチャージ信号（ＮＲＳ）は、画像信号（ＶＩＤ）の反転に対応して、水平帰線期間で画像信号（ＶＩＤ）と同極性の所定レベルとされる。従って、プリチャージ回路駆動信号（ＮＲＧ）がハイレベルとされる時間ｔ２において、プリチャージが行われる。そして、水平帰線期間が終了して有効表示期間が始まる時点よりも時間ｔ４だけ前に、即ち、プリチャージが終了してから画像信号が書き込まれるまでのマージンを時間ｔ４として、プリチャージ回路駆動信号（ＮＲＧ）は、ローレベルとされる。以上のように、検査兼プリチャージ回路２０１は、各水平帰線期間において、プリチャージ信号（ＮＲＳ）を画像信号に先行して複数のデータ線３５に供給する。

【００６０】（検査兼プリチャージ回路の検査機能）次に、図５から図８を参照して、検査兼プリチャージ回路２０１の検査機能について説明する。尚、図５（ａ）は、データ線の開放検査を行っている状態における、データ線駆動回路１０１の一構成例及び検査兼プリチャージ回路２０１の回路図であり、図５（ｂ）は、そのタイミングチャートである。図６は、データ線の短絡検査を行っている状態における、データ線駆動回路１０１の一構成例及び検査兼プリチャージ回路２０１の回路図である。図７は、データ線駆動回路１０１の他の構成例及び検査兼プリチャージ回路２０１の回路図である。図８（ａ）は、当該他の構成例が備えたシフトレジスタの一系列部分の回路図であり、図８（ｂ）は、そのタイミングチャートである。

【００６１】本実施の形態では特に、図１に示したようにデータ線駆動回路１０１及びサンプリング回路３０１は、複数のデータ線３５の一端側に設けられており、検査兼プリチャージ回路２０１は、複数のデータ線の他端側に設けられている。また、図５から図７では、データ線の中央に位置する画素領域を省略し、データ線の一端側の回路構成と他端側の回路構成とを示している。そして、検査時には、検査兼プリチャージ回路２０１に含まれるＴＦＴ２０２は夫々、プリチャージ回路駆動信号線２０６を介してゲート電極にプリチャージ回路駆動信号（ＮＲＧ）が供給されるとオン状態となり、プリチャージ信号線２０４を介してドレイン電極に供給されるプリチャージ信号（ＮＲＳ）を、ソース電極からデータ線３５に対して、検査時には検査信号として供給する。或いは、プリチャージ信号線２０４を介して流れる電流が検査電流として測定される。

【００６２】従って、検査兼プリチャージ回路２０１のＴＦＴ２０２のスイッチング動作を利用して、これらのＴＦＴ２０２とサンプリング回路３０１のＴＦＴ３０２との間に夫々位置する各データ線３５やこれに接続された画素部のＴＦＴ等に対する所定種類の電気特性検査を以下に説明するように行うことが出来る。

【００６３】尚、本実施の形態では、６相展開された画像信号ＶＩＤ１～ＶＩＤ６に対応して画像信号線３０４が６本並列に設けられている場合について説明するが、相展開数や画像信号線３０４の本数は、これに限られるものではない。

【００６４】（１）第１の検査方法

先ず、データ線駆動回路１０１が、図５及び図６に示すように、各段から転送信号を順次出力する１系列のシフトレジスタ３０３と、シフトレジスタ３０３における相隣接する二つの段から相前後して出力される転送信号が時間的に相互に重ならないように転送信号の時間長さを制限した後に、サンプリング回路駆動信号Ｑｎ（ｎ＝１、２、３、…）として出力する波形制御回路３０７を備えた場合について説明する。

【００６５】この場合、図５（ｂ）に示したタイミングで、シフトレジスタ３０３は、スタート信号ＤＸが入力されると、クロック信号ＣＬＸ及びその反転信号に同期して順次転送信号を出力する。そして、図５（ａ）において、波形制御回路３０７では、一方で、イネーブル信号ＥＮＢ１と奇数段から出力される転送信号との非論理積をＮＡＮＤ回路によりとり更にバッファ回路３０８により波形を整形し、他方で、イネーブル信号ＥＮＢ２と偶数段から出力される転送信号との非論理積をＮＡＮＤ回路によりとり更にバッファ回路３０８により波形を整形して、時間的に相互に重ならないサンプリング回路駆動信号Ｑｎ（ｎ＝１、２、３、…）を順次出力する。このようにデータ線駆動回路１０１を構成すると、相前後する転送信号における時間的な重なりに対応して画像信号及び検査信号やプリチャージ信号（ＮＲＳ）が複数のデータ線３５に跨って供給されてしまう事態を未然に防げる。そして、このように構成すれば、検査兼プリチャージ回路２０１に供給するプリチャージ信号（ＮＲＳ）やプリチャージ回路駆動信号（ＮＲＧ）は夫々、前述の如き１Ｈ反転駆動を行わない場合であれば１系列で足りる。また、前述の１Ｈ反転駆動を行う場合でもプリチャージ信号（ＮＲＳ）を２系列にすれば（プリチャージ回路駆動信号（ＮＲＧ）は１系列のままで）足りる。従って、後述する複数系列のシフトレジスタから出力される複数系列の転送信号に基づいてデータ線駆動回路によりサンプリング回路を駆動する場合（図７参照）と比較して、検査兼プリチャージ回路２０１に係る、プリチャージ信号やプリチャージ回路駆動信号用の入出力配線や入

出力端子の数を大幅に減らすことが出来る。尚、図２（３）に示したように相補型ＴＦＴからＴＦＴ２０２を構成する場合には、プリチャージ回路駆動信号ＮＲＧとその反転信号を各ＴＦＴ２０２の二つのゲートに入力する必要がある。この場合、プリチャージ回路駆動信号ＮＲＧとその反転信号とは、２本のプリチャージ回路駆動信号線２０６を介して供給してもよいし、液晶装置２００の内部で、プリチャージ回路駆動信号ＮＲＧから反転信号を生成するようにしてもよい。

【００６６】本実施の形態では、１系列のシフトレジスタ３０３及び波形制御回路３０７を用いているので、画像信号線３０４における電流を測定して以下に説明する検査をデータ線３５毎に行う（即ち、データ線の単位で不良箇所を発見する）ために、プリチャージ回路駆動信号（ＮＲＧ）やプリチャージ信号（ＮＲＳ）の系列数を次式を満たすように設定する。

【００６７】「　画像信号系列数≧　シフトレジスタの系列数　×　同時にオンするデータ線数」

或いは、画像信号線３０４における電流測定の代わりに、後述の第２の検査方法と同様にプリチャージ信号線２０４における電流測定により検査をデータ線毎に行うのであれば、プリチャージ回路駆動信号（ＮＲＧ）やプリチャージ信号（ＮＲＳ）の系列数を次式を満たすように設定する。

【００６８】「　プリチャージ信号の系列数　×　プリチャージ回路駆動信号の系列数≧　シフトレジスタの系列数　×　同時にオンするデータ線数」

尚、これらの式を満たさない場合でも、複数のデータ線からなるグループ単位での検査（不良箇所の発見）は可能であり、単純に製造ラインにおいて不良品を発見して組立工程等の次工程に回さない目的は達成される。但し、不良箇所の分析は、その後の製造技術における不良品率の改善に大変役立つので、本実施の形態のようにデータ線の単位で不良箇所を発見することは非常に重要である。

【００６９】（１－１）データ線の開放又は断線検査

この場合、図５（ａ）に示すように、データ線駆動回路１０１及び走査線駆動回路１０４を通常動作させる。そして、プリチャージ回路２０２における複数のＴＦＴ２０２全てをオン状態としつつ（即ち、プリチャージ回路駆動信号（ＮＲＧ）をハイレベルとしつつ）、プリチャージ信号線２０４に例えば５Ｖといった所定電圧を持つプリチャージ信号（ＮＲＳ）を印加する。すると、プリチャージ信号線２０４に印加された所定電圧は、オン状態とされたＴＦＴ２０２を介して各データ線３５に印加される。そして、各データ線３５に印加された電圧により、サンプリング回路３０１における複数のＴＦＴ３０１がサンプリング回路駆動信号Ｓｎ（ｎ＝１、２、…）により順次オンされることにより各データ線３５と各画像信号線３０４とが導通状態とされた時点で、画像信号線３０４に電流が流れる。そこで、この画像信号線３０４に流れる電流を測定して、データ線３５やこれに接続された画素部のＴＦＴ３０等が正常状態にある場合に得られる基準電流Ｉと比較する。そして、測定電流が基準電流Ｉ±εの範囲（ε：許容或いは誤差範囲）に入っていれば、各データ線３５には、開放又は断線がないと判定できる。逆にこの範囲に入っていなければ各データ線３５には、開放又は断線があると判定できる。

【００７０】尚、この例では、画像信号線３０４の総数が偶数であるので、これらに順にＨ（ハイレベル）、Ｌ（ローレベル）、Ｈ、Ｌ、Ｈ、Ｌのように交互にレベルの異なる電圧を印加すれば一回で、検査が可能である。仮に、画像信号線３０４の総数が奇数であれば、これらにＨ、Ｈ、Ｌ、Ｈ、Ｈ、Ｌ、Ｈ、Ｈ、Ｌ、…のようにレベルの異なる電圧を一回印加した後、Ｌ、Ｌ、Ｈ、Ｌ、Ｌ、Ｈ、Ｌ、Ｌ、Ｈ、…のようにレベルの異なる電圧をもう一回印加すれば、合計２回の電圧印加により同内容の検査が可能となる。

【００７１】（１－２）データ線の短絡検査

この場合、先ず走査線駆動回路１０４の動作を停止させる。そして、図６に示すように、サンプリング回路３０１のＴＦＴ３０２全てをオン状態とする（即ち、シフトレジスタ３０３のスタート信号ＤＸをハイレベルとする）と共にプリチャージ回路２０１のＴＦＴ２０２全てをオフ状態としつつ（即ち、プリチャージ回路駆動信号（ＮＲＧ）をローレベルとしつつ）、相隣接する画像信号線３０４間に所定電圧を印加する。具体的には、画像信号ＶＩＤ１、３、５に対応する画像信号線３０４に例えば、１５Ｖのハイレベル電圧を印加すると共に画像信号ＶＩＤ２、４、６に対応する画像信号線３０４に例えば、０Ｖのローレベル電圧を印加する。すると、ＴＦＴ３０２を介して画像信号線３０４からデータ線３５に所定電圧が印加されるが、ＴＦＴ２０２が全てオフされているため、相隣接するデータ線３５は相互にほぼ絶縁されておりこれらの相隣接する画像信号線３０４間には電流は流れない筈である。そこで、この状態で、相隣接する画像信号線３０４間に流れる電流を測定して、データ線３５等が正常状態にある場合に得られる（ほぼ零に近い）基準電流±ｉと比較する。そして、測定電流が基準電流±ｉの範囲に入っていれば、各データ線３５には、短絡がないと判定できる。逆にこの範囲に入っていなければ各データ線３５には、短絡があると判定できる。

【００７２】（１－３）サンプリング回路のＴＦＴのリーク検査

この場合、先ず走査線駆動回路１０４の動作を停止させる。そして、図６において、サンプリング回路３０１のＴＦＴ３０２全てをオフ状態とする（即ち、シフトレジスタ３０３のスタート信号ＤＸをローレベルとする）と共にプリチャージ回路２０１のＴＦＴ２０２全てをオン状態としつつ（即ち、プリチャージ回路駆動信号（ＮＲ

Ｇ）をハイレベルとしつつ）、プリチャージ信号線２０４に、例えば１２Ｖといった所定電圧を印加する。すると、ＴＦＴ２０２を介してプリチャージ信号線２０４からデータ線３５に所定電圧が印加されるが、サンプリング回路３０１のＴＦＴ３０２スイッチが全てオフされているため、データ線３５の所定電圧によりデータ線３５から画像信号線３０４に電流が流れない筈である。そこで、この状態で、画像信号線３０４に流れる電流を測定して、サンプリング回路３０１のＴＦＴ３０２等が正常状態にある場合に得られる（ほぼ零に近い）基準電流±ｉと比較する。そして、測定電流が基準電流±ｉの範囲に入っていれば、各ＴＦＴ３０２には、リークがないと判定できる。逆にこの範囲に入っていなければ各ＴＦＴ３０２には、リークがあると判定できる。

【００７３】（１－４）プリチャージ回路のＴＦＴのリーク検査

この場合、先ず走査線駆動回路１０４の動作を停止させる。そして、図６において、サンプリング回路３０１のＴＦＴ３０２全てをオン状態とする（即ち、シフトレジスタのスタート信号ＤＸをハイレベルとする）と共にプリチャージ回路２０１のＴＦＴ２０２全てをオフ状態としつつ（即ち、プリチャージ回路駆動信号（ＮＲＧ）をローレベルとしつつ）、プリチャージ信号線２０４に、例えば１２Ｖといった所定電圧を印加する。すると、ＴＦＴ２０２が全てオフされているため、プリチャージ信号線２０４の所定電圧によりデータ線３５及びサンプリング回路３０１のＴＦＴ３０２を介して画像信号線３０４に電流が流れない筈である。そこで、この状態で、画像信号線３０４に流れる電流を測定して、プリチャージ回路２０１のＴＦＴ２０２等が正常状態にある場合に得られる（ほぼ零に近い）基準電流±ｉと比較する。そして、測定電流が基準電流±ｉの範囲に入っていれば、各ＴＦＴ２０２には、リークがないと判定できる。逆にこの範囲に入っていなければ各ＴＦＴ２０２には、リークがあると判定できる。

【００７４】（２）第２の検査方法

次に、データ線駆動回路１０１が、図７に示すように、例えば各段から転送信号を順次出力する４系列８相のシフトレジスタ３０３’を備えた場合（即ち、図５及び図６に示したような波形制御回路３０７を備えない場合）における検査方法について説明する。

【００７５】図７において、シフトレジスタ３０３’の各系列は、スタート信号ＤＸが入力されると、クロック信号ＣＬＸ１及びその反転信号、クロック信号ＣＬＸ２及びその反転信号、クロック信号ＣＬＸ３及びその反転信号、クロック信号ＣＬＸ４及びその反転信号に同期して夫々、順次転送信号（即ち、サンプリング回路駆動信号Ｑ１、Ｑ２、…）を出力する。

【００７６】この場合におけるシフトレジスタの１系列（サンプリング回路駆動信号Ｑ１、Ｑ５、Ｑ９…を出力する系列）を構成する回路部分を抜き出して図８（ａ）に示し、そのタイミングチャートを図８（ｂ）に示す。図８（ｂ）に示したように、シフトレジスタ３０３’の各系列において相隣接する二つの段から相前後して出力される転送信号（即ち、サンプリング回路駆動信号Ｑ１、Ｑ５、Ｑ９、…）は、時間的に相互に重なる。また、他の系列についても同様に、相隣接する二つの段から相前後して出力される転送信号（即ち、サンプリング回路駆動信号Ｑ２、Ｑ６、Ｑ１０、…）は、時間的に相互に重なり、転送信号（即ち、サンプリング回路駆動信号Ｑ３、Ｑ７、Ｑ１１、…）は、時間的に相互に重なり、転送信号（即ち、サンプリング回路駆動信号Ｑ２、Ｑ６、Ｑ１０、…）は、時間的に相互に重なる。

【００７７】従って、データ線駆動回路１０１がこのように構成された場合には、６相展開された画像信号線３０４を利用して同時にオンするデータ線３５の数を制限することにより、図８（ｂ）に示したように相互に重なるサンプリング回路駆動信号Ｑｉにより同一の画像信号線３０４に接続されたサンプリング回路３０１のＴＦＴ３０２を同時に駆動しない構成が採られる。

【００７８】第２の検査方法では、複数系列のシフトレジスタ３０３’を用いているので、プリチャージ信号線２０４における電流を測定して以下に説明する検査をデータ線３５毎に行う（即ち、データ線の単位で不良箇所を発見する）ために、プリチャージ回路駆動信号（ＮＲＧ）やプリチャージ信号（ＮＲＳ）の系列数を次式を満たすように設定する。

【００７９】「　プリチャージ信号の系列数　×（プリチャージ回路駆動信号の系列数×２）≧（シフトレジスタの系列数×２）×　同時にオンするデータ線数」

従って、図７に示した構成例では、プリチャージ回路駆動信号（ＮＲＧ）は２系列（ＮＲＧ１及びＮＲＧ２）とされ、プリチャージ信号（ＮＲＳ）は４系列（ＮＲＳ１、ＮＲＳ２、ＮＲＳ３及びＮＲＳ４）とされる。

【００８０】尚、上記式を満たさない場合でも、或いは、前述した第１の検査方法と同様に画像信号線３０４における電流を測定することによっても、複数のデータ線からなるグループ単位での検査（不良箇所の発見）は可能であり、単純に製造ラインにおいて不良品を発見して組立工程等の次工程に回さない目的は達成される。

【００８１】このように複数系列のシフトレジスタ３０３’を用いる場合には、前述の１系列のシフトレジスタ３０３を用いた場合（図５及び図６参照）と比較すると、プリチャージ信号（ＮＲＳ）やプリチャージ回路駆動信号（ＮＲＧ）用の入出力配線や入出力端子の数は多いが、なお検査回路とプリチャージ回路とを兼用することによる従来の技術に対する本実施の形態における長所が失われるものではない。

【００８２】（２－１）データ線の開放又は断線検査

この場合、図７において、データ線駆動回路１０１及び

走査線駆動回路１０４を通常動作させる。

【００８３】そして、先ず、プリチャージ回路２０２におけるＮＲＧ１系列の複数のＴＦＴ２０２をオン状態とし（即ち、プリチャージ回路駆動信号（ＮＲＧ１）をハイレベルとし）且つ、ＮＲＧ２系列の複数のＴＦＴ２０２をオフ状態としつつ（即ち、プリチャージ回路駆動信号（ＮＲＧ２）をローレベルとしつつ）、画像信号線３０４に例えば５Ｖといった所定電圧を印加する。すると、画像信号線３０４に印加された所定電圧は、サンプリング回路３０１における複数のＴＦＴ３０１がサンプリング回路駆動信号Ｓｎ（ｎ＝１、２、…）により順次オンされることにより各データ線３５と各画像信号線３０４とが導通状態とされた時点で、ＮＲＧ１系列に対応するプリチャージ信号線２０４に電流が流れる。そこで、このプリチャージ信号線２０４に流れる電流を測定して、データ線３５等が正常状態にある場合に得られる基準電流と比較することにより、ＮＲＧ１系列に対応する各データ線３５における開放又は断線の有無を判定できる。

【００８４】次に、プリチャージ回路２０２におけるＮＲＧ２系列の複数のＴＦＴ２０２をオフ状態とし（即ち、プリチャージ回路駆動信号（ＮＲＧ１）をローレベルとし）且つ、ＮＲＧ２系列の複数のＴＦＴ２０２をオン状態としつつ（即ち、プリチャージ回路駆動信号（ＮＲＧ２）をハイレベルとしつつ）、画像信号線３０４に例えば５Ｖといった所定電圧を印加して、上述のＮＲＧ１系列の場合と同様に、ＮＲＧ２系列に対応する各データ線３５における開放又は断線の有無を判定できる。

【００８５】（２－２）データ線の短絡検査

この場合、先ず走査線駆動回路１０４の動作を停止させる。そして、図７において、サンプリング回路３０１のＴＦＴ３０２全てをオフ状態とする（即ち、シフトレジスタのスタート信号ＤＸをローレベルとする）と共にプリチャージ回路２０１のＴＦＴ２０２全てをオン状態としつつ（即ち、プリチャージ回路駆動信号（ＮＲＧ１及びＮＲＧ２）をハイレベルとしつつ）、相隣接するプリチャージ信号線間に所定電圧を印加する。具体的には、プリチャージ信号ＮＲＳ１及びＮＲＳ３に対応するプリチャージ信号線２０４を、例えば１２Ｖのハイレベルにすると共にプリチャージ信号ＮＲＳ２及びＮＲＳ４に対応するプリチャージ信号線２０４を例えば０Ｖのローレベルにする。すると、ＴＦＴ２０２を介してプリチャージ信号線２０４からデータ線３５に所定電圧が印加されるが、ＴＦＴ３０２が全てオフされているため、相隣接するデータ線３５は相互にほぼ絶縁されておりこれらの相隣接するプリチャージ信号線２０４間には電流は流れない筈である。そこで、この状態で、相隣接するプリチャージ信号線２０４間に流れる電流を測定して、データ線３５等が正常状態にある場合に得られる（ほぼ零に近い）基準電流と比較することにより、各データ線３５における短絡の有無を判定できる。

【００８６】（２－３）サンプリング回路のＴＦＴのリーク検査

この場合、先ず走査線駆動回路１０４の動作を停止させ、図７において、サンプリング回路３０１のＴＦＴ３０２全てをオフ状態とする（即ち、シフトレジスタのスタート信号ＤＸをローレベルとする）。

【００８７】そして、先ず、プリチャージ回路２０２におけるＮＲＧ１系列の複数のＴＦＴ２０２をオン状態とし（即ち、プリチャージ回路駆動信号（ＮＲＧ１）をハイレベルとし）且つ、ＮＲＧ２系列の複数のＴＦＴ２０２をオフ状態としつつ（即ち、プリチャージ回路駆動信号（ＮＲＧ２）をローレベルとしつつ）、画像信号線３０４に例えば１２Ｖといった所定電圧を印加する。すると、画像信号線３０４に印加された所定電圧は、サンプリング回路３０１のＴＦＴ３０２スイッチが全てオフされているため、データ線３５及びＴＦＴ２０２を介してプリチャージ信号線２０４に電流が流れない筈である。そこで、この状態で、プリチャージ信号線２０４に流れる電流を測定して、サンプリング回路３０１のＴＦＴ３０２等が正常状態にある場合に得られる（ほぼ零に近い）基準電流と比較することにより、ＮＲＧ１系列に対応するサンプリング回路３０１の各ＴＦＴ３０２におけるリークの有無を判定できる。

【００８８】次に、プリチャージ回路２０２におけるＮＲＧ２系列の複数のＴＦＴ２０２をオフ状態とし（即ち、プリチャージ回路駆動信号（ＮＲＧ１）をローレベルとし）且つ、ＮＲＧ２系列の複数のＴＦＴ２０２をオン状態としつつ（即ち、プリチャージ回路駆動信号（ＮＲＧ２）をハイレベルとしつつ）、画像信号線３０４に例えば１２Ｖといった所定電圧を印加して、上述のＮＲＧ１系列の場合と同様に、ＮＲＧ２系列に対応するサンプリング回路３０１の各ＴＦＴ３０２におけるリークの有無を判定できる。

【００８９】（２－４）プリチャージ回路のＴＦＴのリーク検査

この場合、先ず走査線駆動回路１０４の動作を停止させる。そして、図７において、サンプリング回路３０１のＴＦＴ３０２全てをオン状態とする（即ち、シフトレジスタのスタート信号ＤＸをハイレベルとする）と共にプリチャージ回路２０１のＴＦＴ２０２全てをオフ状態としつつ（即ち、プリチャージ回路駆動信号（ＮＲＧ１及びＮＲＧ２）をローレベルとしつつ）、画像信号線３０４に例えば１２Ｖといった所定電圧を印加する。すると、画像信号線３０４に印加された所定電圧は、プリチャージ回路３０２のＴＦＴ２０２スイッチが全てオフされているため、ＴＦＴ３０２及びデータ線３５を介してプリチャージ信号線２０４に電流が流れない筈である。そこで、この状態で、プリチャージ信号線２０４に流れる電流を測定して、プリチャージ回路２０１のＴＦＴ２

０２等が正常状態にある場合に得られる（ほぼ零に近い）基準電流と比較することにより、プリチャージ回路２０１の各ＴＦＴ２０２におけるリークの有無を判定できる。

【００９０】以上のように本実施の形態における検査兼プリチャージ回路２０１は、液晶装置２００への組み立て工程前やスクライブ工程前などに実施される検査の際には検査機能を持ち、液晶装置２００への組み立て後の通常動作の際にはプリチャージ機能を持つ。このため、従来のように検査回路とプリチャージ回路とを別々に基板の周辺部分に設ける場合と比較して、これら二つの機能を実現するために必要な基板上の領域が顕著に小さくて済む。特に、従来のように通常動作時には不要となる検査用端子や検査用配線を専用に設ける必要がなく、プリチャージ用の入出力配線や入出力端子などを検査用に兼用できるので、大変有利である。更に、従来のように不要となった検査用端子が腐食して当該アクティブマトリクス基板やこれを組み込んだ液晶装置に悪影響を及ぼしたり、検査用回路や検査用配線の不良化が、当該アクティブマトリクス基板や液晶装置全体としての不良化に繋がる可能性が低減されるため、二重に有利である。

【００９１】（液晶装置の全体構成）次に、以上説明した検査兼プリチャージ回路２０１を含むアクティブマトリクス基板を備えた液晶装置の全体構成例を、図９及び図１０を参照して説明する。ここに、図９は、液晶装置を対向基板の側から見た平面図であり、図１０は、図９のＨ－Ｈ’断面図である。

【００９２】図９及び図１０において、ＴＦＴアレイ基板１の上には、複数の画素電極１１により規定される画面表示領域（即ち、実際に液晶層５０の配向状態変化により画像が表示される液晶装置の領域）の周囲において両基板を貼り合わせて液晶層５０を包囲するシール部材の一例としての光硬化性樹脂からなるシール材５２が、画面表示領域に沿って設けられている。そして、対向基板２上における画面表示領域とシール材５２との間には、遮光性の周辺見切り５３が設けられている。

【００９３】周辺見切り５３は、後に画面表示領域に対応して開口が開けられた遮光性のケースにＴＦＴアレイ基板１が入れられた場合に、画面表示領域が製造誤差等によりケースの開口の縁に隠れてしまわないように、即ち、例えばＴＦＴアレイ基板１のケースに対する数百μｍ程度のずれを許容するように、画面表示領域の周囲に５００μｍ以上の幅を持つ帯状の遮光性材料から形成されたものである。このような遮光性の周辺見切り５３は、例えば、Ｃｒ（クロム）、Ｎｉ（ニッケル）、Ａｌ（アルミニウム）等の金属材料を用いたスパッタリング、フォトリソグラフィ及びエッチングにより対向基板２に形成される。或いは、カーボンやＴｉ（チタン）をフォトレジストに分散した樹脂ブラックなどの材料から形成される。

【００９４】シール材５２の外側の領域には、画面表示領域の下辺に沿ってデータ線駆動回路１０１及び実装端子１０２が設けられており、画面表示領域の左右の２辺に沿って走査線駆動回路１０４が画面表示領域の両側に設けられている。更に画面表示領域の上辺には、画面表示領域の両側に設けられた走査線駆動回路１０４間をつなぐための複数の配線１０５が設けられている。また、対向基板２のコーナー部の少なくとも１箇所において、ＴＦＴアレイ基板１と対向基板２との間で電気的導通をとるための導通材からなる銀点１０６が設けられている。そして、シール材５２とほぼ同じ輪郭を持つ対向基板２が当該シール材５２によりＴＦＴアレイ基板１に固着されている。

【００９５】本実施の形態では特に、検査兼プリチャージ回路２０１及びサンプリング回路３０１は、対向基板２に形成された遮光性の周辺見切り５３に対向する位置においてＴＦＴアレイ基板１上に設けられており、データ線駆動回路１０１及び走査線駆動回路１０４は、液晶層５０に面しないＴＦＴアレイ基板１の狭く細長い周辺部分上に設けられている。

【００９６】検査兼プリチャージ回路２０１及びサンプリング回路３０１は、通常動作時には、基本的に交流駆動の回路である。このため、シール材５２により包囲され両基板間に挟持された液晶層５０に面するＴＦＴアレイ基板１部分にこれらの検査兼プリチャージ回路２０１及びサンプリング回路３０１を設けても、直流電圧印加による液晶層５０の劣化という問題は生じない。これに対して、データ線駆動回路１０１及び走査線駆動回路１０４は、液晶層５０に面することのないＴＦＴアレイ基板１の周辺部分に設けられている。従って、液晶層５０に、特に直流駆動されるデータ線駆動回路１０１や走査線駆動回路１０４からの直流電圧成分が、漏れ込んで印加されることを未然に防止できる。

【００９７】そして、このように周辺見切り５３下に、検査兼プリチャージ回路２０１及びサンプリング回路３０１を設けることで、走査線駆動回路１０４やデータ線駆動回路１０１をＴＦＴアレイ基板１の周辺部分に余裕を持って形成することができ、特定の仕様に沿うようにこれらの周辺回路を設計することが容易になる。

【００９８】本実施の形態では更に、プリチャージ信号線２０４及びプリチャージ回路駆動信号線２０６（図１参照）についても、周辺見切り５３に対向する位置においてＴＦＴアレイ基板１に設けられている。この場合、検査兼プリチャージ回路２０１は、通常動作時には、基本的に交流駆動の回路であるため、液晶層５０に面するＴＦＴアレイ基板１部分にこのようなプリチャージ信号線２０４とプリチャージ回路駆動信号線２０６とを設けても、直流電圧印加による液晶の劣化という問題は生じない。そして、このように周辺見切り５３下に、２種類の入出力配線を設ければ、液晶装置における有効表示面

積の減少を招くことはない。

【００９９】（液晶装置の細部構成）次に、液晶装置の各画素部等の具体的構成について図１１から図１４を参照して説明する。ここに、図１１は、液晶装置の相隣接する画素部の平面図であり、図１２は、液晶装置の検査兼プリチャージ回路を構成するＴＦＴの平面図である。また、図１３は、図１１のＡ－Ａ’断面及び図１２のＢ－Ｂ’断面を示す断面図であり、図１４は、図１１のＣ－Ｃ’断面を示しており、液晶装置の周辺見切り下に配線されたプリチャージ信号線に沿った断面図である。尚、図１３及び図１４においては、各層や各部材を図面上で認識可能な程度の大きさとするため、各層や各部材毎に縮尺を異ならしめてある。

【０１００】図１１の平面図に示すように、画面表示領域内において、複数の画素電極１１は、ＴＦＴアレイ基板１上にマトリクス状に配列され、各画素電極１１に隣接してＴＦＴ３０（破線で囲った領域）が設けられており、また画素電極１１の縦横の境界に夫々沿ってデータ線３５並びに走査線３１及び容量線３１’が設けられている。データ線３５は、コンタクトホール３７を介して半導体層３２のソース領域と電気的接続されており、半導体層３２のチャネル領域（図１１の右下がり斜線部）において走査線３１の一部であるゲート電極により制御される。半導体層３２のドレイン領域はコンタクトホール３８を介して画素電極１１と電気的接続されている。また、画素電極１１に蓄積容量を付加するために、容量線３１’を配設する。蓄積容量は、半導体層３２のドレイン領域から延設された第１蓄積容量電極３２’と前記容量線（第２蓄積容量電極）３１’との間の層間絶縁層（例えば後述するゲート絶縁層）を誘電体として形成する。尚、容量線３１’を走査線と同一工程でポリシリコン膜等により形成する場合は、データ線と同一工程で形成されるＡｌ等の低抵抗金属や金属シリサイドからなる定電位線５０１とコンタクトホール５０２を介して電気的接続すると良い。このような構成を採ることにより、容量線３１’の低抵抗化が実現できる。また、図１１に示すように定電位線５０１は画面表示領域の周辺に設けられる周辺回路に供給される電源等から延設し、周辺見切り５３の領域に配線するようにすれば、専用の外部入力端子を設ける必要がなくなり、更に周辺見切り５３といった従来デッドスペースであった領域に配線を形成することにより、液晶装置の小型化が実現できる。

【０１０１】また、図１２の平面図に示すように、検査兼プリチャージ回路２０１においては、プリチャージ信号線２０４、プリチャージ回路駆動信号線２０６及びデータ線３５が平行に配置されている。プリチャージ信号線２０４は、各コンタクトホール３７”を介して各ＴＦＴ２０２のソース領域に電気的接続されており、データ線３５は各コンタクトホール３８”を介して各ＴＦＴ２０２のドレイン領域に電気的接続されている。また、プリチャージ回路駆動信号線２０６はＴＦＴ２０２のゲート電極として、これらのソース領域とドレイン領域とを結ぶチャネル部分にゲート絶縁膜を介して対向配置されている。

【０１０２】図１３の断面図における図１１のＡ－Ａ’断面部分に示すように、液晶装置は画素部において、ＴＦＴアレイ基板１並びにその上に積層された第１層間絶縁層４１、半導体層３２、ゲート絶縁層３３、走査線３１（ゲート電極）、第２層間絶縁層４２、データ線３５（ソース電極）、第３層間絶縁層４３、画素電極１１及び配向膜１２を備えており、画素毎にＴＦＴ３０が設けられている。また、液晶装置は画素部において、例えばガラス基板から成る対向基板２並びにその上に積層された共通電極２１、配向膜２２及び遮光膜２３を備えており、更に、これらの両基板間に挟持された液晶層５０を備えている。

【０１０３】第１層間絶縁層４１、第２層間絶縁層４２及び第３層間絶縁層４３は夫々、ＮＳＧ、ＰＳＧ、ＢＳＧ、ＢＰＳＧなどのシリケートガラス膜、窒化シリコン膜や酸化シリコン膜等からなる。画素電極１１は例えば、ＩＴＯ膜（インジウム・ティン・オキサイド膜）などの透明導電性薄膜やＡｌ等の反射率の高い不透明な材料からなる。配向膜１２及び２２は、例えばポリイミド薄膜などの有機薄膜からなる。共通電極２１は、ＩＴＯ膜等からなり、対向基板２の全面に渡って形成されている。遮光膜２３は、ＴＦＴ３０に対向する所定領域に設けられており、前述の周辺見切り５３同様に金属材料や樹脂ブラックなどから形成され、ＴＦＴ３０の半導体層３２に対する遮光の他に、コントラストの向上、色材の混色防止などの機能を有する。液晶層５０は、ＴＦＴアレイ基板１と対向基板２との間において、シール材５２（図９及び図１０参照）により囲まれた空間に液晶が真空吸引等により封入されることにより形成され、例えば一種又は数種類のネマティック液晶を混合した液晶からなる。シール材５２は、例えば光硬化性樹脂や熱硬化性樹脂からなる接着剤であり、両基板間の距離を所定値とするためのスペーサが混入されている。

【０１０４】ＴＦＴ３０は、走査線３１（ゲート電極）、走査線３１からの電界によりチャネルが形成される半導体層３２、走査線３１と半導体層３２とを絶縁するゲート絶縁層３３、半導体層３２に形成されたソース領域３４、データ線３５（ソース電極）、及び半導体層３２に形成されたドレイン領域３６を備えている。ドレイン領域３６には、複数の画素電極１１のうちの対応する一つが接続されている。ソース領域３４及びドレイン領域３６は後述のように、半導体層３２に対し、Ｎ型又はＰ型のチャネルを形成するかに応じて所定濃度のＮ型用又はＰ型用のドーパントをドープすることにより形成されている。

【０１０５】ＴＦＴ３０を構成する半導体層３２は、例

えば、下地としての第１層間絶縁層４１上にａ－Ｓｉ（アモルファスシリコン）膜を形成後、アニール処理を施して約５００～２０００Åの厚さに固相成長させることにより形成する。前記半導体層３２は、Ｐチャネル型のＴＦＴ３０の場合には、Ｓｂ（アンチモン）、Ａｓ（砒素）、Ｐ（リン）などのＶ族元素のドーパントを用いたイオン注入等によりドープする。また、Ｎチャネル型のＴＦＴ３０の場合には、Ｂ（ボロン）、Ｇａ（ガリウム）、Ｉｎ（インジウム）などのIII族元素のドーパントを用いたイオン注入等によりドープすることにより、ソース領域３４およびドレイン領域３６を形成する。また、ＴＦＴ３０をＬＤＤ（Ｌｉｇｈｔｌｙ　Ｄｏｐｅｄ　Ｄｒａｉｎ　Ｓｔｒｕｃｔｕｒｅ）構造を持つＮチャネル型のＴＦＴとする場合、ソース領域３４及びドレイン領域３６のうちチャネル側に夫々隣接する一部にＰ（リン）などのＶ族元素のドーパントにより低濃度ドープ領域を形成し、同じくＰ（リン）などのＶ族元素のドーパントにより高濃度ドープ領域を形成する。また、Ｐチャネル型のＴＦＴ３０とする場合、Ｂ（ボロン）などのIII族元素のドーパントを用いてソース領域３４及びドレイン領域３６を形成する。尚、ＴＦＴ３０は、オフセット構造のＴＦＴとしてもよいし、セルフアライン型のＴＦＴとしてもよい。また、画素スイッチング用のＴＦＴ３０は、高速に書き込むことが可能なＮチャネル型ＴＦＴを用いることが多い。

【０１０６】このように、本実施の形態の液晶装置は、画素スイッチング用のＴＦＴ３０を形成するＴＦＴアレイ基板１上にＰチャネル型ＴＦＴ及びＮチャネル型ＴＦＴがほぼ同一工程で形成することが可能なため、画面表示領域の外側の周辺部に図９に示すようにデータ線駆動回路１０１や走査線駆動回路１０４等の周辺回路を画素と同一基板上に形成することができる。これにより、駆動回路を外付けする必要がなくなり、コスト及び液晶装置の小型化に大変有利になる。

【０１０７】ゲート絶縁層３３は、半導体層３２を約９００～１３００℃の温度により熱酸化することにより、３００～１５００Å程度の比較的薄い厚さの熱酸化膜を形成して得る。或いは、熱による基板のそりを防ぐために、前記熱酸化膜上に酸化シリコン膜や窒化シリコン膜を形成し、多層なゲート絶縁層３３を形成しても良い。

【０１０８】走査線３１（ゲート電極）は、減圧ＣＶＤ法等によりポリシリコン膜を堆積した後、フォトリソグラフィ工程、エッチング工程等により形成される。或いは、Ｗ（タングステン）、Ｍｏ（モリブデン）、Ｔａ（タンタル）等の高融点金属膜や金属シリサイド膜等の金属合金膜から形成されてもよい。この場合、走査線３１（ゲート電極）を、遮光膜２３が覆う領域の一部又は全部に対応する遮光膜として配置すれば、金属膜や金属シリサイド膜の持つ遮光性により、遮光膜２３の一部又は全部を省略することも可能となる。この場合特に、対向基板２とＴＦＴアレイ基板１との貼り合わせずれによる画素開口率の低下を防ぐことが出来る利点がある。

【０１０９】データ線３５（ソース電極）は、画素電極１１と同様にＩＴＯ膜等の透明導電性薄膜から形成してもよい。或いは、スパッタリング処理等により、約１０００～５０００Åの厚さに堆積されたＡｌ（アルミニウム）等の低抵抗金属や金属シリサイド等の金属合金膜から形成してもよい。Ａｌ（アルミニウム）のような遮光性の高い膜でデータ線３５を形成すれば、データ線３５を対向基板上に設けられた遮光膜２３の代用が可能となり、この場合にも、対向基板２とＴＦＴアレイ基板１との貼り合わせずれによる画素開口率の低下を防ぐことが出来る利点がある。

【０１１０】また、第２層間絶縁層４２には、データ線３５と半導体層のソース領域３４を電気的接続するためのコンタクトホール３７が開孔されている。更に、第２相関絶縁層４２及び第３層間絶縁層４３には、半導体層のドレイン領域３６へのコンタクトホール３８が開孔されている。この半導体層のドレイン領域３６へのコンタクトホール３８を介して、画素電極１１は半導体層のドレイン領域３６に電気的接続される。前述の画素電極１１は、このように構成された第３層間絶縁層４３の上面に設けられている。

【０１１１】画素電極１１には、ＴＦＴ３０に隣接して蓄積容量７０が夫々付加されている。この蓄積容量７０は、より具体的には、半導体層３２のドレイン領域３６から延設された第１蓄積容量電極３２’、ゲート絶縁層３３と同一工程により形成される絶縁層３３’、走査線３１と同一工程により形成される容量線３１’（第２蓄積容量電極）、第２及び第３層間絶縁層４２及び４３、並びに第２及び第３層間絶縁層４２及び４３を介して容量線３１’に対向する画素電極１１の一部から構成されている。このように蓄積容量７０が設けられているため、デューティー比が小さくても高精細な表示が可能とされる。

【０１１２】次に、図１３の断面図における図１２のＢ－Ｂ’断面部分（図の左側）に示すように、液晶装置には、検査兼プリチャージ回路２０１のＴＦＴ２０２（図１参照）がデータ線３５毎に設けられている。このＴＦＴ２０２は、より具体的には、半導体層３２と同一工程により形成される半導体層３２”、ゲート絶縁層３３と同一工程により形成されるゲート絶縁層３３”及び走査線３１と同一工程により形成されるプリチャージ回路駆動信号線２０６を備えている。半導体層３２”には、ＴＦＴ３０の場合と同様に、チャネル領域を挟んでソース領域３４”及びドレイン領域３６”が設けられ、第２層間絶縁層４２に開孔されたコンタクトホール３７”及び３８”を夫々通じてドレイン領域３６”にはデータ線３５が接続され、ソース領域３４”にはプリチャージ信号線２０４が接続されている。そして、このような層構造

を持つＴＦＴ２０２は、対向基板２に設けられた遮光性の周辺見切り５３に対向する位置において、ＴＦＴアレイ基板１上に設けるようにするとよい。これにより、従来デッドスペースであった周辺見切り５３の領域を有効利用することができるため、液晶装置の小型化が実現できる。

【０１１３】図１４の断面図に示すように、周辺見切り５３に対向する位置において複数の走査線３１上の第２層間絶縁層４２上部をプリチャージ信号線２０４やプリチャージ回路駆動信号線２０６が通過する。そして、これらのプリチャージ信号線２０４及びプリチャージ回路駆動信号線２０６は、その殆どの部分がデータ線３５と同一工程で形成されたＡｌ等の金属薄膜で形成された低抵抗な配線である。このように、周辺見切り５３の領域にプリチャージ信号線２０４及びプリチャージ回路駆動信号線２０６を配線形成することにより、従来デッドスペースであった領域を有効利用することができるため、液晶装置の小型化が実現できる。

【０１１４】尚、図１１から図１４には図示していないが、サンプリング回路３０１のＴＦＴ３０２（図１参照）は、検査兼プリチャージ回路２０１のＴＦＴ２０２と同様に構成されており、対向基板２に設けられた遮光性の周辺見切り５３に対向する位置において、ＴＦＴアレイ基板１上に設けるようにするとよい。これにより、データ線駆動回路１０１の占有面積を拡大することができるため、より多機能な液晶装置を実現することができる。或いは、液晶装置を小型化する際に有利であることは、言うまでもない。

【０１１５】尚、図１１から図１４には示されていないが、対向基板２の投射光が入射する側及びＴＦＴアレイ基板１の投射光が出射する側には夫々、例えば、ＴＮ（ツイステッドネマティック）モード、ＳＴＮ（スーパーＴＮ）モード、Ｄ－ＳＴＮ（ダブル－ＳＴＮ）モード等の動作モードや、ノーマリーホワイトモード／ノーマリーブラックモードの別に応じて、偏光フィルム、位相差フィルム、偏光板などが所定の方向で配置される。また、対向基板２には適宜、ＲＧＢのカラーフィルタ、ダイクロイックフィルタ、マイクロレンズ等を形成してもよい。更に、ＴＦＴアレイ基板１に、特開平９－１２７４９７号公報、特公平３－５２６１１号公報、特開平３－１２５１２３号公報、特開平８－１７１１０１号公報等に開示されているように、ＴＦＴ３０の下側にも、例えば高融点金属からなる遮光層を設けてもよい。

【０１１６】本実施の形態の液晶装置は、各種の液晶材料（液晶相）、動作モード、液晶配列、駆動方法等に適用可能である。

【０１１７】（電子機器）次に、以上詳細に説明した実施の形態における液晶装置１００を備えた電子機器の実施の形態について図１５から図１８を参照して説明する。

【０１１８】先ず図１５に、液晶装置１００及びその駆動回路１００４を備えた電子機器の概略構成を示す。

【０１１９】図１５において、電子機器は、表示情報出力源１０００、表示情報処理回路１００２、駆動回路１００４、液晶装置１００、クロック発生回路１００８並びに電源回路１０１０を備えて構成されている。表示情報出力源１０００は、ＲＯＭ（Read Only Memory）、ＲＡＭ（Random Access Memory）、光ディスク装置などのメモリ、画像信号を同調して出力する同調回路等を含み、クロック発生回路１００８からのクロック信号に基づいて、所定フォーマットの画像信号などの表示情報を表示情報処理回路１００２に出力する。表示情報処理回路１００２は、増幅・極性反転回路、相展開回路、ローテーション回路、ガンマ補正回路、クランプ回路等の周知の各種処理回路を含んで構成されており、クロック信号に基づいて入力された表示情報からデジタル信号を順次生成し、クロック信号CLKと共に駆動回路１００４に出力する。駆動回路１００４は、液晶装置１００を駆動する。電源回路１０１０は、上述の各回路に所定電源を供給する。尚、液晶装置１００を構成するＴＦＴアレイ基板の上に、駆動回路１００４を搭載してもよく、これに加えて表示情報処理回路１００２を搭載してもよい。

【０１２０】次に図１６から図１８に、このように構成された電子機器の具体例を夫々示す。

【０１２１】図１６において、電子機器の一例たる液晶プロジェクタ１１００は、上述した駆動回路１００４がＴＦＴアレイ基板上に搭載された液晶装置１００を含む液晶モジュールを３個用意し、夫々ＲＧＢ用のライトバルブ１００Ｒ、１００Ｇ及び１００Ｂとして用いたプロジェクタとして構成されている。液晶プロジェクタ１１００では、メタルハライドランプ等の白色光源のランプユニット１１０２から投射光が発せられると、３枚のミラー１１０６及び２枚のダイクロイックミラー１１０８によって、ＲＧＢの３原色に対応する光成分Ｒ、Ｇ、Ｂに分けられ、各色に対応するライトバルブ１００Ｒ、１００Ｇ及び１００Ｂに夫々導かれる。この際特にＢ光は、長い光路による光損失を防ぐために、入射レンズ１１２２、リレーレンズ１１２３及び出射レンズ１１２４からなるリレーレンズ系１１２１を介して導かれる。そして、ライトバルブ１００Ｒ、１００Ｇ及び１００Ｂにより夫々変調された３原色に対応する光成分は、ダイクロイックプリズム１１１２により再度合成された後、投射レンズ１１１４を介してスクリーン１１２０にカラー画像として投射される。

【０１２２】図１７において、電子機器の他の例たるマルチメディア対応のラップトップ型のパーソナルコンピュータ（ＰＣ）１２００は、上述した液晶装置１００がトップカバーケース内に備えられており、更にＣＰＵ、メモリ、モデム等を収容すると共にキーボード１２０２が組み込まれた本体１２０４を備えている。

【０１２３】また図１８に示すように、駆動回路１００４や表示情報処理回路１００２を搭載しない液晶装置１００の場合には、駆動回路１００４や表示情報処理回路１００２を含むＩＣ１３２４がポリイミドテープ１３２２上に実装されたＴＣＰ（Tape Carrier Package）１３２０に、ＴＦＴアレイ基板１の周辺部に設けられた異方性導電フィルムを介して物理的且つ電気的に接続して、液晶装置１００として、生産、販売、使用等することも可能である。

【０１２４】以上図１６から図１８を参照して説明した電子機器の他にも、液晶テレビ、ビューファインダ型又はモニタ直視型のビデオテープレコーダ、カーナビゲーション装置、電子手帳、電卓、ワードプロセッサ、エンジニアリング・ワークステーション（ＥＷＳ）、携帯電話、テレビ電話、ＰＯＳ端末、タッチパネルを備えた装置等などが図１５に示した電子機器の例として挙げられる。

【０１２５】

【発明の効果】本発明のアクティブマトリクス基板によれば、検査兼プリチャージ回路は、液晶装置への組み立て工程前やスクライブ工程前などに実施される検査の際には検査機能を持ち、液晶装置への組み立て後の通常動作の際にはプリチャージ機能を持つので、従来のように検査回路とプリチャージ回路とを別々に基板の周辺部分に設ける場合と比較して、これら二つの機能を実現するために必要な基板上領域が顕著に小さくて済む。特に、従来のように通常動作時には不要となる検査用端子や検査用配線を専用に設ける必要がなく、プリチャージ用の入出力配線や入出力端子などを検査用に兼用できるので、大変有利である。

【０１２６】本発明の液晶装置や電子機器によれば、各種の電気特性検査が確実に行われているために信頼性が高く、また周辺回路を余裕を持って高仕様に設計可能であり、信頼性の高い高品位動作を行える。更に装置全体の小型化も可能である。

【０１２７】本発明のアクティブマトリクス基板の検査方法によれば、比較的容易に、開放又は断線検査、短絡検査等の各種の電気的検査を確実に行える。

【図面の簡単な説明】

【図１】本発明によるアクティブマトリクス基板の実施の形態に設けられた各種配線、周辺回路等の等価回路図である。

【図２】アクティブマトリクス基板の実施の形態に設けられた検査兼プリチャージ回路を構成するＴＦＴの回路図である。

【図３】アクティブマトリクス基板の実施の形態に設けられたサンプリング回路を構成するＴＦＴの回路図である。

【図４】アクティブマトリクス基板の実施の形態に設けられた検査兼プリチャージ回路の通常動作時における各種信号のタイミングチャートである。

【図５】アクティブマトリクス基板の実施の形態に設けられたデータ線駆動回路の一構成例と検査兼プリチャージ回路との回路図（図５（ａ））、及びそのデータ線開放検査における各種信号のタイミングチャート（図５（ｂ））である。

【図６】図５に示した回路のデータ線短絡検査における状態を示した回路図である。

【図７】アクティブマトリクス基板の実施の形態に設けられたデータ線駆動回路の他の構成例と検査兼プリチャージ回路との回路図である。

【図８】図７のデータ線駆動回路の他の構成例に備えられたシフトレジスタの一系列に係る部分を抜粋して示す回路図（図８（ａ））及びそのタイミングチャート（図８（ｂ））である。

【図９】本発明による液晶装置の実施の形態の全体構成を示す平面図である。

【図１０】図９のＨ－Ｈ’断面図である。

【図１１】液晶装置の実施の形態における画素部の平面図である。

【図１２】液晶装置の実施の形態における検査兼プリチャージ回路を構成するＴＦＴの平面図である。

【図１３】図１１のＡ－Ａ’断面及び図１２のＢ－Ｂ’断面を示す断面図である。

【図１４】図１１のＣ－Ｃ’断面を示す断面図である。

【図１５】本発明による電子機器の実施の形態の概略構成を示すブロック図である。

【図１６】電子機器の一例としての液晶プロジェクタを示す断面図である。

【図１７】電子機器の他の例としてのパーソナルコンピュータを示す正面図である。

【図１８】電子機器の他の例としてのＴＣＰを用いた液晶装置を示す斜視図である。

【符号の説明】

１…ＴＦＴアレイ基板
２…対向基板
１１…画素電極
３０…ＴＦＴ
５０…液晶層
５２…シール材
５３…周辺見切り
７０…蓄積容量
１００…液晶装置
１０１…データ線駆動回路
１０４…走査線駆動回路
２０１…検査兼プリチャージ回路
２０２…ＴＦＴ
２０４…プリチャージ信号線
２０６…プリチャージ回路駆動信号線
３０１…サンプリング回路

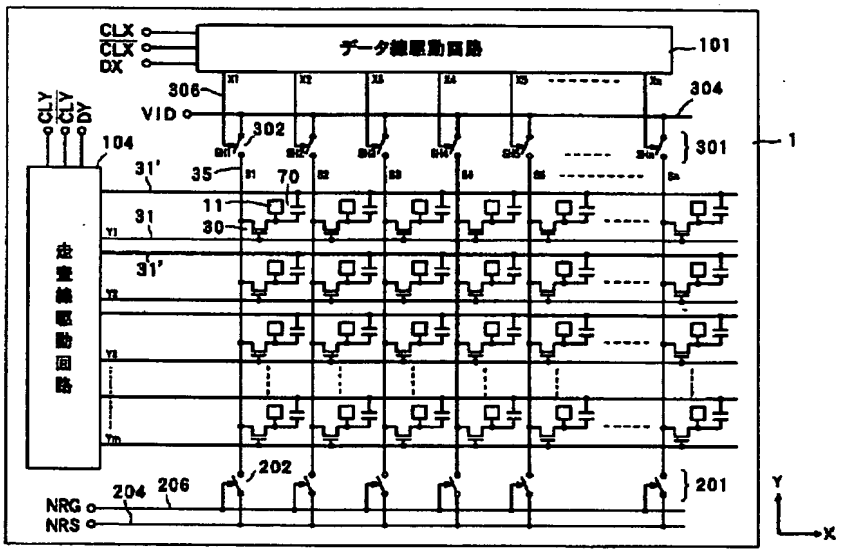
35

３０２…ＴＦＴ
３０４…画像信号線

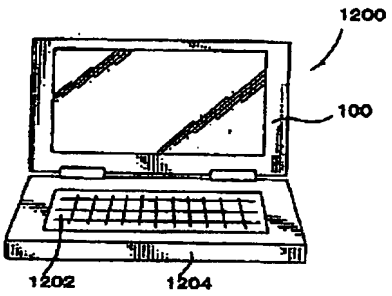
36

３０６…サンプリング回路駆動信号線
３０７…波形制御回路

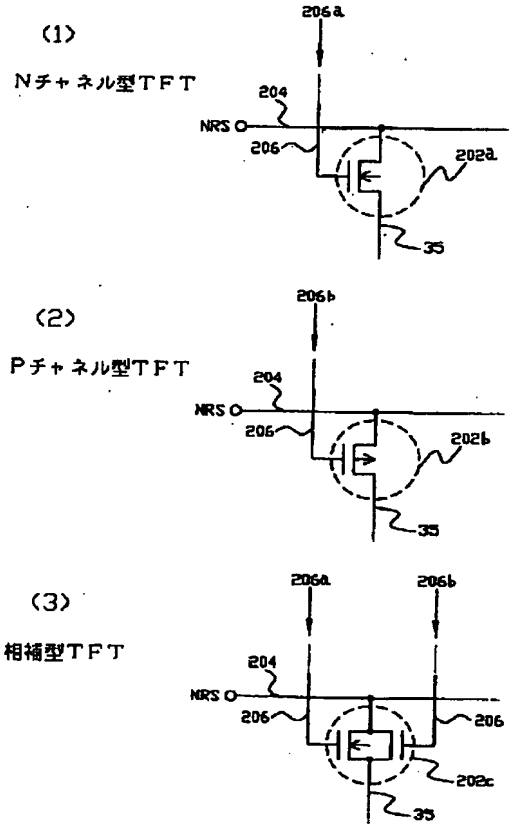
【図１】



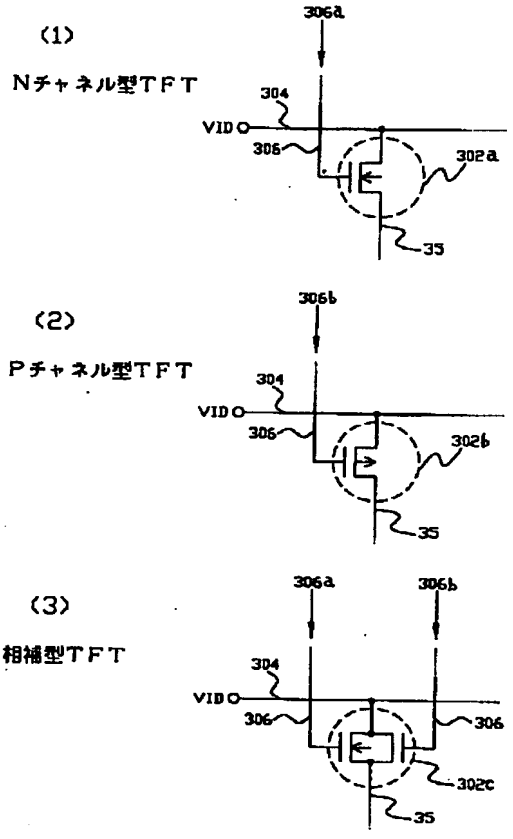
【図１７】



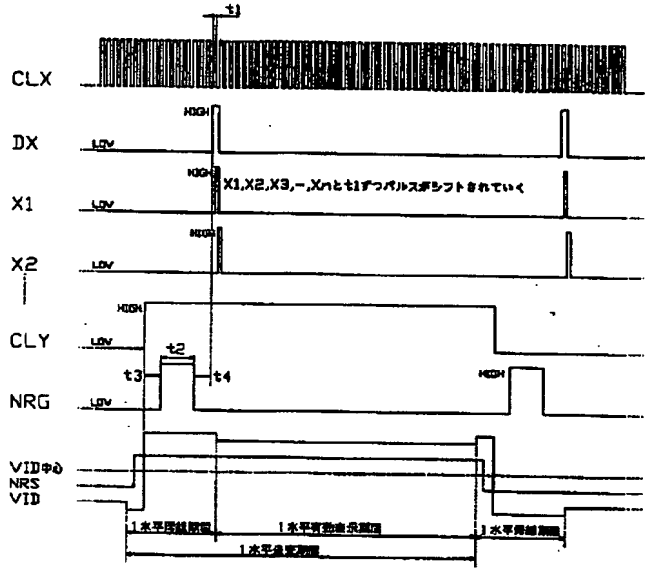
【図２】



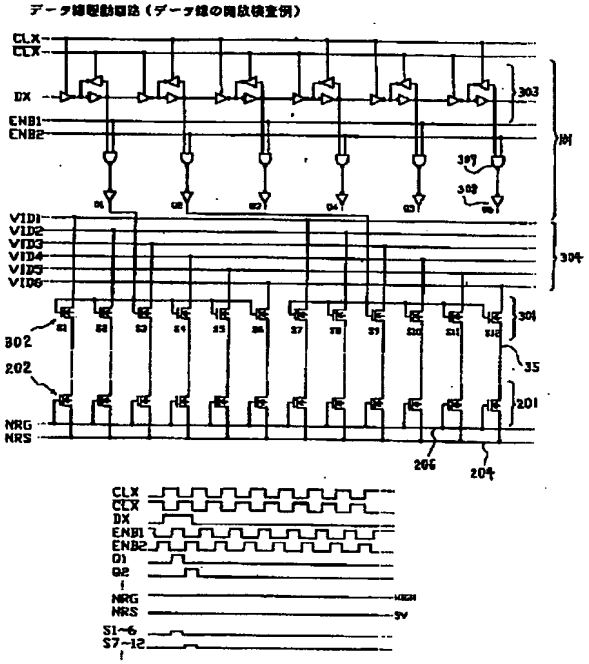
【図３】



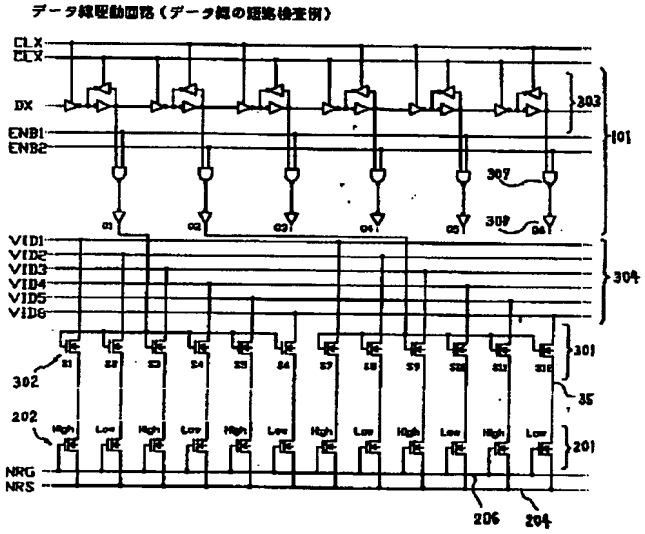
【図４】



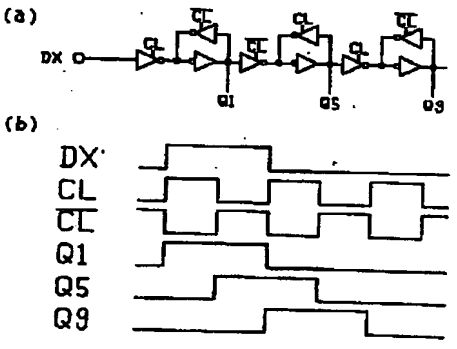
【図５】



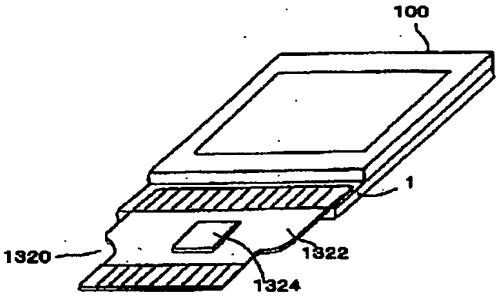
【図６】



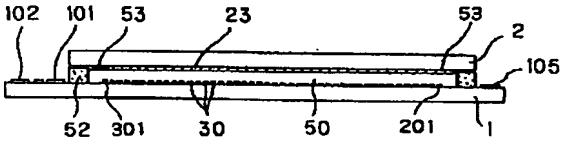
【図８】



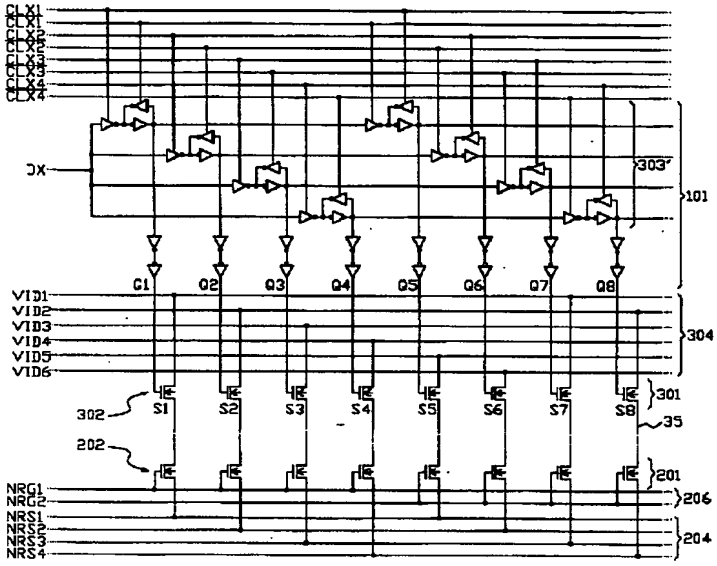
【図１８】



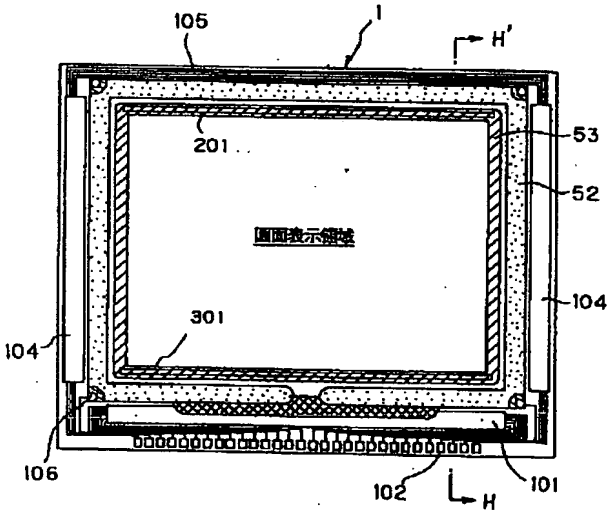
【図１０】



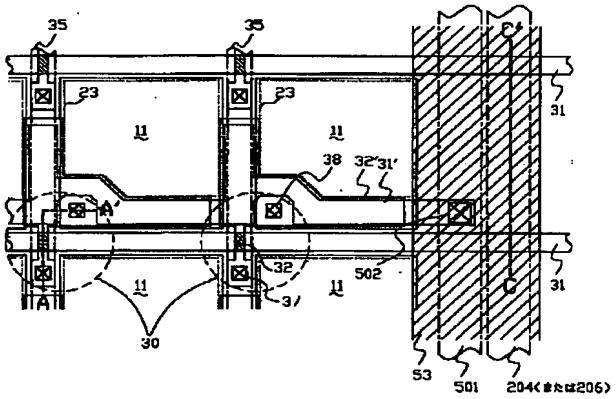
【図７】


DX
303'
101
Q1
Q2
Q3
Q4
Q5
Q6
Q7
Q8
VID1
VID2
VID3
VID4
VID5
VID6
304
302
S1
S2
S3
S4
S5
S6
S7
S8
301
35
202
201
NRG1
NRG2
206
204

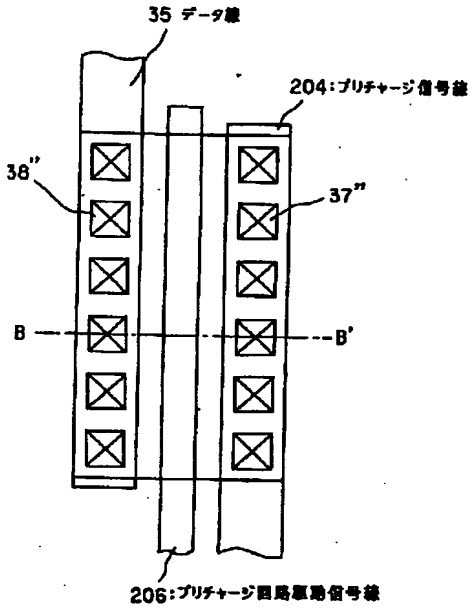
【図９】


105
1
H'
201
53
52
104
301
106
102
101
H

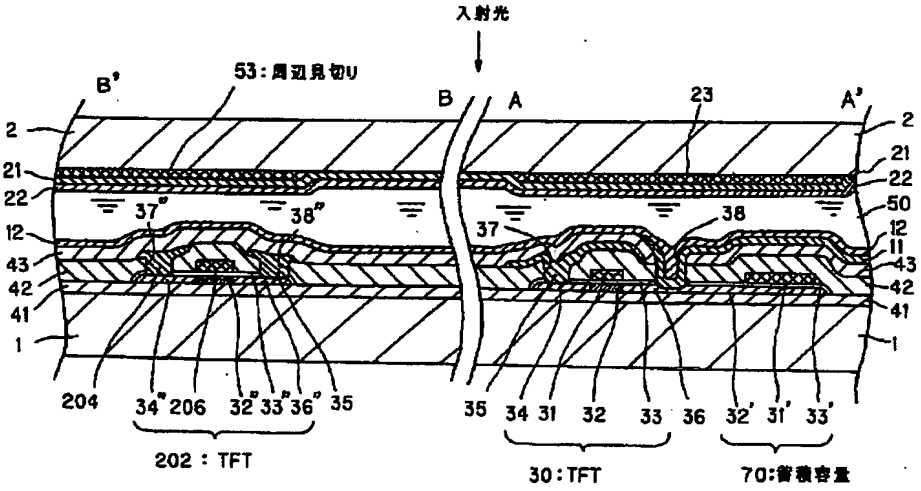
【図１１】


35
35
23
23
11
11
38
32'
31'
A
A'
32
31
502
11
11
30
31
53
501
204(または206)

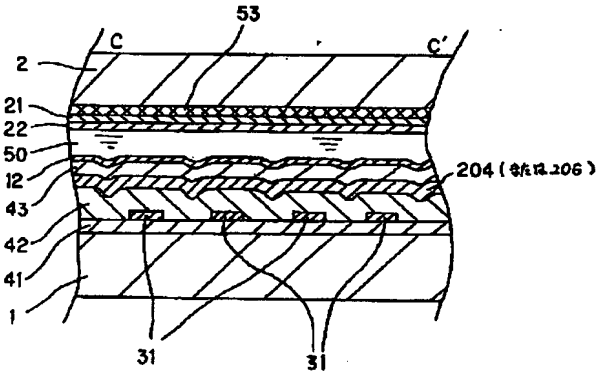
【図１２】


35 データ線
204:プリチャージ信号線
38''
37''
B
B'
206:プリチャージ回路駆動信号線

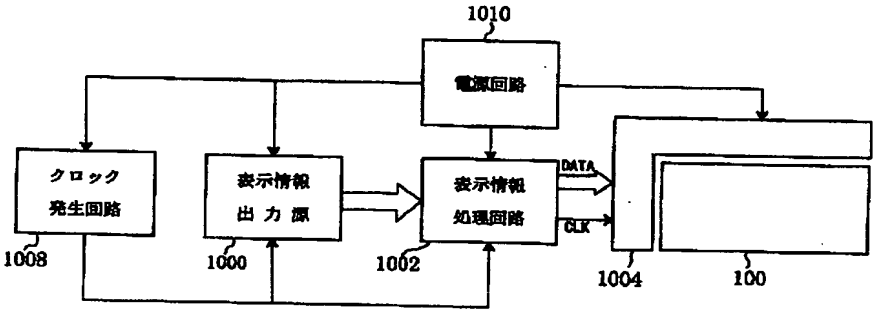
【図１３】


入射光
B'
53:周辺見切り
B
A
23
A'
2
21
22
37''
38''
12
43
42
41
1
204
34''
206
32''
33''
36''
35
202 : TFT
35
34
31
32
33
36
32'
31'
33'
30:TFT
70:蓄積容量

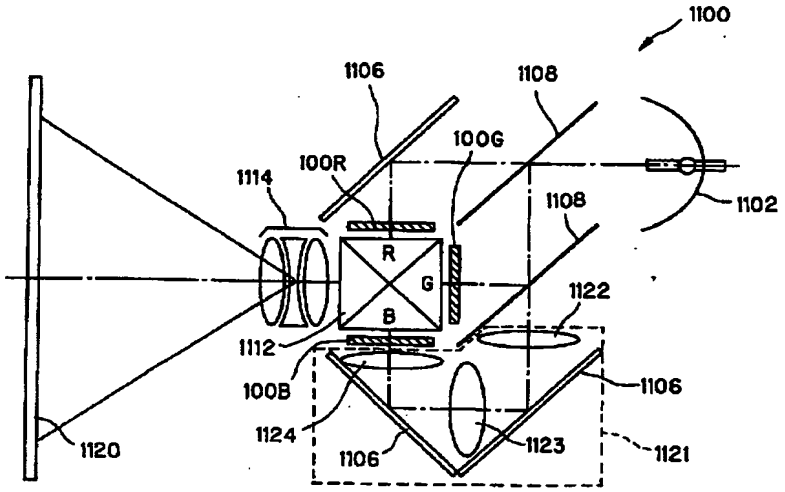
【図１４】


53
C
C'
2
21
22
50
12
43
42
41
1
204 (または206)
31
31

【図１５】


1010
電源回路
クロック
発生回路
1008
表示情報
出力源
1000
表示情報
処理回路
1002
DATA
CLK
1004
100

【図１６】


1100
1106
1108
100G
100R
1114
1102
1108
R
G
B
1122
1112
100B
1106
1124
1123
1121
1106
1120